Fisheries Report 03-01

RECREATIONAL SPECIALIZATION, PREFERENCES, AND MANAGEMENT ATTITUDES OF TROUT ANGLERS UTILIZING TENNESSEE TAILWATERS

A Final Report Submitted to the
Tennessee Wildlife Resources Agency




Clifford P. Hutt, M.S.
Tennessee Cooperative Fishery Research Unit

Phillip W. Bettoli, Ph.D.
U.S. Geological Survey, Biological Resources Division

Tennessee Technological University
Cookeville, TN

January 2003

Fisheries Report 03-01

RECREATIONAL SPECIALIZATION, PREFERENCES, AND MANAGEMENT ATTITUDES OF TROUT ANGLERS UTILIZING TENNESSEE TAILWATERS

A Final Report Submitted to the Tennessee Wildlife Resources Agency

Clifford P. Hutt, M.S.
Tennessee Cooperative Fishery Research Unit

Phillip W. Bettoli, Ph.D.
U.S. Geological Survey, Biological Resources Division

Tennessee Technological University
Cookeville, TN

January 2003

Development of this report was financed in part by funds from Federal Aid in Fish and Wildlife Restoration (Public Law 91-503) as documented in Federal Aid Project FW- 6 (TWRA Project 7307).

Executive Summary

(1) The attitudes and motivations of trout anglers who fished eight tailwater fisheries in middle and eastern Tennessee were examined in 2001-2002.

(2) Using a stratified random sampling design, anglers were contacted and interviewed on-site (n = 2,643). They were also asked to complete a questionnaire that examined their attitudes and motivations towards trout fishing; anglers who agreed (n = 1,942) were mailed a 10-page survey. The response rate to the mail survey was 75% after excluding surveys that were undeliverable.

(3) The average age of anglers interviewed on-site was 44 years and they were twice as likely to be fishing with bait (68%) as with artificial lures and flies (32%). They were predominantly male (96%) and most (54%) had household annual incomes between $20,000 and $60,000; 15% reported incomes less than $20,000. Eighty-six percent of the interviewed anglers were Tennessee residents. Anglers were split evenly between those who received schooling past high school and those who did not.

(4) Most (69%) of the anglers we interviewed ranked trout as their most preferred sportfish species. When adjusted for non-responses, anglers fished for trout an average of 32 days per year and had nearly 16 years of trout fishing experience.

(5) Angler subgroups were created using hierarchical cluster analyses of fourteen variables related to angling experience, resource use, investment, and centrality of fishing to their lifestyle. Five groups of anglers were identified and nonhierarchical cluster analysis determined the size of each group, which ranged from 178 to 369 anglers.

(6) Subgroup 1, the most specialized of the five subgroups, was labeled *Non-consumptive Specialists* and represented 19% of respondents. Most anglers in this group reported that fishing was their primary means of recreation and nearly all of their fishing trips targeted trout. They invested heavily in fishing equipment and rarely harvested trout.

(7) A second subgroup, the *Occasional Trout Anglers*, was comprised of specialized anglers who usually did not target trout. Fishing was an important form of recreation for them, but they devoted less time and money to fishing than anglers in subgroup 1. They also represented about 19% of the respondents.

(8) Anglers in subgroup 3, labeled *Casual Trout Anglers*, were the least specialized fishermen in general, but they spent more time and effort fishing for trout than the occasional trout anglers of subgroup 2. Anglers in this subgroup, representing 21% of all respondents, ranked lowest in the importance of fishing to their lifestyle.

(9) Subgroup 4 was the second most specialized subgroup of anglers, the *Consumptive Specialists*. This was the largest subgroup, or about 28% of all respondents. These anglers overwhelmingly targeted trout and they fished an average of 42 days per year. Angling was an important form of recreation for them and they invested a modest amount of money in fishing. In contrast to non-consumptive specialists, anglers in this subgroup were much more likely to harvest and eat the trout they caught.

(10) Anglers in subgroup 5, the smallest subgroup (13% of respondents), were intermediate in their level of specialization to anglers in the other groups. These anglers were labeled *Fishing Generalists* and they averaged 35 days of trout fishing per year, which represented 58% of all their fishing trips. They tended to harvest the trout they caught and they had the second most money invested in fishing equipment.

(11) Subgroup attitudes differed significantly in regards to the importance of harvesting trout and catching trophy trout. Higher-specialization anglers supported more stringent regulations. The most disparate mean rankings among subgroups were for the motive "obtaining fish to eat".

(12) The two specialist subgroups (consumptive and non-consumptive specialists) tended to rank non-catch and catch related motives higher than the other three subgroups. Anglers in the two specialist subgroups had nearly identical mean responses to several key motivations such as catching a trophy, experiencing the catch, and developing their skills.

(13) The only regulation not favored by most anglers in all subgroups was establishing closed fishing seasons. Most anglers in all groups supported minimum size limits and establishing spawning refuges. Attitudes towards creel limits, catch-and-release-only areas, and prohibition of bait varied significantly among subgroups.

(14) Consumptive specialists were the single largest angler group (25-35% of all respondents) at five of the eight rivers surveyed (Caney Fork, Clinch , Elk , South Fork of the Holston, and Watauga Rivers). On the Duck, Hiwassee, and Obey Rivers, consumptive specialists were the second largest group. On the Duck and the Obey Rivers, more anglers were assigned to the occasional trout anglers subgroup and on the Hiwassee River, non-consumptive specialists were the most common subgroup. The fishing generalists subgroup was the smallest or second smallest group on each river.

(15) Harvest frequencies varied only slightly among tailwaters with the exception of the Obey River, where 67% of anglers reported harvesting trout 'often' or 'always'. Lowest harvest frequencies were reported on the South Holston and Watauga Rivers, where about 50% of the anglers harvested trout 'rarely' or 'never'.

(16) Mean scores for the eleven catch preference statements differed little among tailwaters, with a few exceptions. Anglers on the Obey were much more likely to agree that they preferred to keep rather than release their catch and that bringing trout home to eat was an important outcome of fishing.

(17) Mean rankings for nine fishing regulations presented to anglers differed among tailwaters. For instance, support for slot limits was high on the Caney Fork and South Fork of the Holston Rivers, but support was only modest elsewhere. Conversely, bait restrictions received little support across all rivers.

(18) Randomly-assigned hypothetical catch scenarios consisting of different numbers and sizes of trout were presented to anglers on-site and satisfaction ratings were solicited (n = 2,186 responses). Categorical modeling of variances revealed that the size of trout they caught influenced angler satisfaction more than the number of trout they caught.

(19) The occasional trout angler and fishing generalist subgroups were probably the most substitutable subgroups in this study, meaning that their preferences and needs were less specific than the other subgroups and could be met by a wider variety of fisheries. Consumptive and non-consumptive specialists were the least substitutable subgroups because they spent 80-90% of their fishing trips targeting trout using specific gear and techniques, which means that their satisfaction was closely tied to a specific type of fishing experience.

(20) The Caney Fork, Clinch, and Hiwassee Rivers had the most uniform distributions of anglers among the five subgroups and the potential for conflicts over management decisions will be relatively high at those rivers. With such a diverse clientele to satisfy, managers could steer less specialized anglers to other fisheries in the area if changes in management were contemplated, or choose to maintain the status quo. The Duck River and the Obey River fisheries were dominated by less specialized subgroups (occasional and casual trout anglers and fishing generalists) and with their low potential to produce trophy trout, those two rivers should continue to be managed as put-and-take trout fisheries. Finally, the fisheries on the Elk, South Fork of the Holston, and Watauga Rivers were dominated by the most specialized subgroups (consumptive specialists and non-consumptive specialists), which suggests that the majority of anglers on those rivers would accept restrictive regulations.

TABLE OF CONTENTS

INTRODUCTION

Fisheries managers historically followed the principle of maximum sustainable yield (MSY), the strategy of producing the greatest physical yield of fish possible, to guide their management actions (Nielsen 1993). This dictum looked upon fish as crops whose harvest should be maximized and required no consideration of sociological concerns. Although MSY was often a management goal, the quality of a fishing trip could be influenced by factors other than just the size and number of fish caught, such as comradery and the aesthetic value of the area (McFadden 1969). These social values had little influence on management decisions until the 1960s when the influence of public opinion on government decisions greatly increased (Nielsen 1993). This eventually led to the principle of optimum sustainable yield (OSY), which was outlined in a 1975 symposium (Roedel 1975) and incorporated both sociological and economic concerns into the decision making process, along with biological and ecological concerns (Nielsen 1993).

According to OSY, fisheries have three common components: the aquatic organism of interest, the habitat they live in, and the people that pursue or take interest in them (Nielsen 1993). All three components are capable of affecting each other and can be manipulated to benefit a fishery. Unfortunately, the effects of the people (i.e., anglers) involved in a fishery are often oversimplified. In the past, most studies that examined anglers viewed them as a homogeneous group in an attempt to define the average angler (Hendee and Bryan 1978). However, over the last quarter century many researchers in the fields of sociology and fisheries management have concluded that the "average angler" does not exist and that angler populations are actually comprised of heterogeneous subgroups with a wide range of often conflicting motivations and expectations (McFadden 1969; Bryan 1976). Quantitatively defining these differing preferences can be of great use to fisheries managers when making management decisions (Ditton 1977).

The main problem with the idea of the "average angler" is that different anglers pursue different sources of satisfaction from the resource that represents the fishery (Bryan 1982). Hendee (1974) referred to this as the concept of multiple satisfaction. Hendee's ground-breaking work on the subject dealt with hunters, but his primary idea holds true with all recreationalists. Hendee (1974) stated "recreational resources offer people the opportunity for a range of experiences which, in turn, give rise to various human satisfactions." With the knowledge of the multiple satisfactions sought by the anglers that frequent a given fishery, fisheries managers can regulate fisheries resources in a way that optimizes angler satisfaction (Hendee 1974; Bryan 1982). This is essentially the goal of optimum sustainable yield.

The problem with the concept of multiple satisfactions when applied by itself is that sources of satisfaction are often site or resource specific and anglers will fish different bodies of water for different reasons (Bryan 1982). Due to differing expectations, a satisfactory experience at one location may be unsatisfactory at another. This generates a need for a conceptual framework that can separate angler subgroups while cutting across different settings or fisheries. Recreational specialization is such a concept (Bryan 1977).

Bryan's (1977) definition of recreational specialization proposes that anglers can be divided into subgroups along "a continuum of behavior from the general to the particular." At one end of the continuum is the novice angler who only fishes occasionally and who's fishing preferences are very broad in nature (Bryan 1979). At the other end of the continuum is the highly specialized angler who fishes frequently and has very specific preferences as to where, how, and what he or she pursues when fishing. A prime example of the specialized angler is the fly-fishing purest. Bryan's initial study involved trout fisherman to whom he posed questions regarding their: (1) fishing preferences, (2) orientation to the stream fisheries, (3) past interest and involvement in the sport, and (4) relationship of angling to their lives in general. In addition, he also took notes on their techniques, skill, and social surroundings (e.g., did they fish alone or with friends and family). His methodology was not quantitatively rigorous, and he did not attempt to distribute his sampling in a proportional manner. His goal was to develop a conceptual framework that could guide future studies that were statistically sound. Bryan (1977) developed four angler typologies with his initial study. The four groups were: (1) occasional anglers who fished rarely, and could be new to fishing or have done so for many years, (2) generalists, who fished frequently but used several techniques, (3) technique specialists who specialized in a certain method, and (4) technique-setting specialists who are not only specialized in a given technique, but also on fishing certain types of water bodies (e.g., streams versus lakes). Later studies of a more quantitative nature have developed additional subgroups depending on their statistical methods and the type of angler population they targeted (Graefe 1980; Chipman and Helfrich 1988; Fisher 1997; Romberg 1999).

Graefe (1980) proposed using the simple measure of angling frequency as an alternative indicator of specialization. He felt that most managers required an approach that was simpler and less time consuming than the standard multivariate studies proposed by Bryan (1977). Graefe (1980) concluded that angling frequency was a good substitute for measuring recreational specialization since increased participation in the sport is a characteristic of higher specialization. Chipman (1986) examined specialization among Virginia river anglers using a multivariate approach and cluster analysis to develop angler typologies. His study made inquires into the angler's use of the resource, experience, monetary investment in fishing equipment, and the centrality of angling to their lifestyle. Chipman's statistical analysis identified more detailed angler subgroups, and subsequent studies that followed Chipman's have sought to improve upon his statistical techniques (Fisher 1997; Romberg 1999).

Statistical technique aside, the basic concept of recreational specialization implies that beginners to a sport start out with unspecialized behavior. Individuals eventually grow increasingly specialized in their recreational behavior with time and increased participation (Chipman 1986). However, it has been suggested that this progression of specialization can be impeded or accelerated by an individual's socio-economic status, how they were introduced to the sport, and events that occur in their lives (Kuentzel and McDonald 1992). Either way, it is generally held that as a participant's level of specialization increases, their orientation to the resource tends to shift from one of consumption to one of preservation,

with greater consideration placed on the overall experience (Bryan 1977). In angling this is represented by a move from harvesting fish to practicing catch-and-release. This is a very important point for fisheries managers making decisions involving the proper allocation of fishery resources.

As anglers move along the continuum of specialization from the general to the specialized, their needs and desires gradually shift from being very broad in nature to very specific (Bryan 1977). As a result, the experiences that they must seek for a satisfactory outing become more defined and less substitutable. Since anglers of low specialization have broader preferences, it is easier for them to find satisfaction from different resources than the one they would initially seek, hence they are very "substitutable" (Bryan 1982). This is the exact opposite for the highly specialized angler whose preferences are specific, and their options for sources of satisfaction are fewer in number.

Cleveland (1995) conducted a mail survey of Tennessee anglers that had purchased sportsman licenses, which combine all fishing and hunting permits into one license. He used Graefe's (1980) technique to divide anglers into subgroups with different levels of involvement, and examined anglers' motivations and fishing preferences. A key finding was that anglers who fished the most were more interested in catching trophy fish and releasing the fish they caught. Those anglers also placed more emphasis on motives directly connected to fishing, as opposed to more general motives for recreating, such as relaxation. However, only anglers that bought sportsman licenses were surveyed; thus, results could have been biased because sportsman licenses are generally purchased by more serious outdoorsmen. Cleveland (1995) supported the assertion that sportsman license holders tended to be more specialized anglers by comparing the mean angling frequency (46 days/angler/year) of the Tennessee anglers who were surveyed to the mean angling frequency (16 days/ angler/year) of the general angling public of the United States (U.S. Department of Interior 1991).

In the present study, trout anglers that utilized eight tailwater fisheries located throughout Tennessee were surveyed. The objectives of this project were to (1) assign trout anglers that utilized eight tailwater fisheries into recognizable subgroups based on their angling behavior, (2) define primary motivations for each subgroup, describe the angling preferences of subgroups, (4) statistically compare angler acceptance and support for various management options, and (5) determine which subgroups dominated each of the individual tailwater fisheries.

STUDY AREAS

This study encompassed eight tailwater rivers located in middle and eastern Tennessee. Summerfelt (1999) defined a tailwater as being "the river area immediately downstream from a dam that is strongly influenced by the fluctuations in reservoir discharge." The dams associated with the tailwaters in this study all feature deep water releases. As a result, the water released from these dams is cold year round. The cold water released by the dams has resulted in the decline of populations of native warmwater fishes in the rivers. Rainbow trout *Oncorhynchus mykiss* and brown trout *Salmo trutta* are

stocked in the rivers to mitigate for the loss of native sportfish. For the purposes of this study, a tailwater was described as the reach of river below a dam where water temperatures remain cold enough to support a trout fishery. All of the dams were built for the purposes of flood control, water supply, and, with one exception (Normandy Dam on the Duck River) hydroelectric power. Data collected from previous creel surveys (e.g., catch rates, angling pressure, etc.) conducted on each of the eight tailwater rivers are listed in Appendix A (e.g., Bettoli and Bohm 1997; Devlin and Bettoli 1999; Bettoli et al. 1999).

METHODS

Survey Design and Implementation

Anglers fishing for trout on the Caney Fork, Obey, Duck, Elk, Hiwassee, Clinch, Watauga, and South Holston rivers were contacted on-site between February 2001 and January 2002. Sampling was conducted using a roving creel survey. Three weekend days and three weekdays were randomly sampled by a creel clerk each month. Each sample day was divided into AM and PM work shifts that had equal probabilities of being sampled.

Anglers that agreed to participate were asked several questions relating to the economic value of the fisheries as part of a concurrent study. When the on-site survey was completed, they were asked if they would be willing to participate in a follow-up mail survey that included the questions examined for this study. Those that agreed to participate were sent a 40-item questionnaire (Appendix B) and a cover letter within two months of their initial contact. Survey questions, format, and administration of the survey followed Dillman's (1978) Total Design Method. Two reminders were mailed out about 10 and 30 d after the first mailing. The last reminder included a new survey in the event the original survey was misplaced.

Descriptive Findings

All variables were summarized for the entire sample of survey respondents in order to provide baseline, descriptive data. Frequency distributions were generated for survey questions using ordinal scales. Frequency distributions and summary statistics (means, standard errors) were calculated for all continuous variables.

Nonresponse Bias

Survey variables were adjusted and tested for nonresponse bias using methods outlined by Fisher (1996), with a few modifications. Wilcoxon rank sum tests and chi-square tests were used to test for differences in mean age, years of trout angling experience, education and income between respondents and nonrespondents to determine whether adjustments for nonresponse bias were needed. Surveyed anglers were then assigned a binary variable reflecting their response status (0 = nonrespondents, 1 = repondents). Logistic regression was used to determine each angler's response probability (Agresti 1990). The angler's

response status was the independent variable in the analysis and several demographic and angling behavior variables collected in the on-site survey were used as the independent variables (Table 1).

Survey variables were adjusted for nonresponse using the method of response propensity stratification (Little 1986). Anglers were sorted in ascending order based on their response probabilities and were then divided into groups of 40 individuals, with the last group having 43. Response probabilities were averaged within each group and the inverted average was assigned to each member of the group for their nonresponse adjustment weight (NAW). Response probabilities were averaged to reduce variance inflation caused by extreme response probabilities. Respondent survey variables were multiplied by their NAW, summed, and divided by the total number of anglers surveyed (respondents plus nonrespondents) to calculate the adjusted population means. Adjusted means were determined to be significantly different from unadjusted means if their 95% confidence intervals did not include the adjusted mean.

Angler Specialization

The 12-page mail survey was used to collect data on an individual's angling behavior and experience, equipment investment, fishing preferences, motivations, opinions on fisheries management options, and general demographic information (Appendix B). Data from 15 of the 40 questions were used to generate angler sub-groups, and the questions were broken into four categories devised by Chipman (1986): resource use, experience, investment, and centrality of angling to lifestyle (Table 2). Resource use questions examined the percentage of an anglers fishing effort directed at trout, species preferences, and how often the angler harvested trout (Bryan 1977, 1983; Chipman 1986). The experience questions inquired into the number of years an angler had been fishing for trout, and the number of trout fishing trips they had made in the last year (Chipman 1986). The investment questions examined the angler's monetary investment in trout fishing equipment (Wellman et al. 1982; Chipman 1986). The questions on centrality of angling to lifestyle examined length of fishing vacations, maximum distances traveled to fish, and the role of fishing in their life (Bryan 1980; Wellman et al. 1982; Chipman 1986).

Answers to most questions followed an ordinal category format; experience questions were left open-ended to provide continuous data (Chipman 1986). Final answers to the 15 questions used to generate angler subgroups were standardized to a minimum score of 0 and a maximum of 1. Standardized scores of 0 indicated low specialization while scores of 1 indicated high specialization (Chipman 1986). Scores were summed within each dimension, and then standardized once again to 0 or 1 to give each dimension equal weighting.

Cluster analysis techniques followed those used by Fisher (1997). Hierarchical cluster analysis was used to determine the number of angler subgroups. Two different methods were used to ensure that the number of clusters formed was consistent. They were Ward's minimum variance and McQuitty's method (SAS Institute 1988). The number of angler subgroups was determined by plotting the number of clusters generated by each iteration

against the cubic clustering criterion (i.e., value at which various groups of clusters are formed; Aldenderfer and Blashfield 1984; Fisher 1997.)

The size of angler subgroups was determined by nonhierarchical cluster analysis after the number of clusters had been determined by hierarchical cluster analysis. We used a convergence value of 0.02 to determine the seeds, or mean index values, for the clusters. The reason for using both hierarchical and nonhierarchical cluster analysis techniques is best explained in two points. First, hierarchical clustering analysis can determine the number of clusters when that factor is unknown, but certain methods (e.g., Ward's) have an inherent bias towards generating clusters of similar sizes (SAS Institute 1988; Chipman 1986). Secondly, this bias is not a problem with nonhierarchical cluster analysis, but this method requires the researcher to designate the number of clusters prior to analysis (Milligan 1980; Fisher 1996).

Angler Motivations and Preferences

Four multiple-part questions were included in the survey to ask anglers about their motivations for fishing, angling preferences, and opinions on certain management regulations and practices (Appendix B). All used a balanced, five-point Likert-type scale to measure the importance or level of agreement an angler placed on a given point (Graefe 1980). The first question asked anglers about the importance of 14 possible sources of motivation for trout fishing (1, very unimportant; 2, unimportant; 3, neutral; 4, important; 5, very important). These included both general reasons for fishing (e.g., relaxation), and resource oriented reasons (e.g., catching fish to eat).

The second question examined angler agreement with 11 statements pertaining to an angler's preferences relating to catch and harvest. This question determined the importance to the angler's satisfaction of catching lots of trout, the size of trout caught, the harvest or release of the trout caught, the method with which the trout were caught, and the type of trout caught.

The third question asked anglers if they would oppose or support nine types of potential fisheries regulations if they were used on the river they fished most often. The fourth question asked anglers how important they thought four management actions were to improving and maintaining trout fishing in Tennessee. Answers for these questions were averaged within angler subgroups, and then compared between subgroups using categorical data models and paired contrasts. This was done to determine if subgroups were significantly different in regards to motivations, catch preferences, and opinions on management.

Demographics

Ten questions at the end of the survey collected demographic information about the anglers. These data were used to describe the demographics of the anglers that utilized different tailwaters and the anglers in different subgroups. Comparisons were made between tailwaters and subgroups using either categorical data models with paired

contrasts or analysis of variance (ANOVA) with Tukey's multiple comparison test, depending on whether the data were discrete or continuous in nature.

Size and Number Preferences

In addition to the economic questions, anglers interviewed on the eight rivers were also asked to rate their satisfaction with two hypothetical catch scenarios using methods adapted from Petering et al. (1995) and their satisfaction with current fishing conditions on the tailwaters. These questions were added to the on-site survey in July. Anglers were first presented with hypothetical catch scenarios that consisted of a predetermined number of trout, all of the same size; they were then asked to rate what their satisfaction would be with such a catch on a 1 (lowest) to 5 (highest) scale. The catch scenarios consisted of 1, 3, 5, or 7 trout that were either 203, 254, 305, or 356 mm long. The creel clerk told the angler how many trout were in the catch scenario and the size was visually communicated by a silhouette of a trout drawn on a 152 mm by 406 mm piece of plastic. The silhouettes were used to reduce potential bias caused by angler misconceptions of trout size. After being presented with the hypothetical catch scenarios, anglers were asked to rate their satisfaction with the current fishing conditions on the river on the same five-point scale.

Creel clerks supplied with a list of 400 randomly-ordered catch scenarios were instructed to present two scenarios to each angler interviewed. If they completed the list, they went back to the beginning. A pilot study in June 2001 analyzed the variability of the rankings for each catch scenario. The percentage of times a catch scenario appeared in the list was equal to the proportion of the total variance each catch scenario contributed to the pilot-study (Table 3).

The data were analyzed with categorical data models in SAS (Petering et al. 1995). The angler's satisfaction ratings served as the dependent variable and the independent variables were the river on which the angler was interviewed, the size of trout and number of trout in the catch scenario, and the interaction between size and number. Analysis of weighted least-squares was used to calculate test statistics.

RESULTS

Survey Response

Clerks interviewed 2,643 trout anglers between February 2001 and January 2002 at the eight tailwaters targeted in this study, of which 1,942 agreed to participate in the mail survey (i.e., 74% participation rate). Of 1,864 deliverable surveys, 75% were returned with usable answers, yielding a 55% overall response rate when accounting for the anglers that did not agree to participate in the mail survey.

Nonresponse Bias

Mean age varied significantly between respondents and nonrespondents ($Z = -4.86$; $P = 0.0001$) as did mean years of trout angling experience ($Z = -3.41$; $P = 0.0007$), angling method used when interviewed ($\chi^2 = 22.4$; df = 1; $P = 0.001$), level of education ($\chi^2 = 117.2$; df = 7; $P = 0.001$), and household income ($\chi^2 = 53.2$; df = 5; $P = 0.001$) (Table 4). Respondents on average tended to be older (Figure 1), more educated, and have higher household incomes (Table 4). Anglers in both groups were predominantly bait anglers, but artificial lures were used by more respondents (36.6%) than non-respondents (27.9%) (Figure 2). The differences between respondents and nonrespondents showed that angler response was not completely random, and adjustment of survey variables was needed to reduce nonresponse bias.

Based on logistic regression analysis, three on-site survey variables (education, age, and angling method) were selected for the model to determine angler response probabilities (Table 5). The model was then used to adjust survey variable means for nonresponse bias. All of the adjusted means were less than the means calculated for respondents. Frequency of fishing in general and for trout specifically were the only variables whose adjusted means were not significantly different from their respondent means. It is important to note that only population means were adjusted for non-response. Means calculated for subgroups within the population could not be adjusted.

Descriptive Findings

Demographics

Interviewed anglers averaged 44 years of age (Table 4), and 96% were male. Eighty-four percent of anglers had at least a high school education and 28% had at least a four-year college degree. Most (54%) anglers reported household incomes ranging from $20,000 to $59,999. Eighty-six percent of survey respondents were Tennessee residents. The non-resident respondents were from 20 states (Table 6). Most (61%) respondents reported living in either a rural area or a small town (Table 7).

Angling Behavior

Sixty-nine percent of respondents ranked trout as their most preferred sportfish (Table 8). Anglers averaged 49 fishing trips in the past year and 67% of those trips targeted trout (Table 9). Anglers averaged 29 years of general fishing experience and 16 years of trout fishing experience. Fly fishing was used ‘often’ or ‘always’ by 33% of trout anglers while 43% of anglers reported the same for the use of other artificial lures (e.g., spinners and plugs). Lastly, 54% of anglers reported using bait either ‘often’ or ‘always’ (Table 10). The percentages relating to how often survey respondents used different angling techniques summed to greater than 100% because many anglers reported using more than one technique ‘often’ or ‘always’. Forty-six percent of anglers considered themselves to be experienced anglers, but only 8% rated themselves as being experts at the sport (Table 11).

Fifty-six percent of survey respondents reported having less than $500 invested in trout fishing equipment (Table 12). Forty-four percent of respondents reported that they went on vacations specifically to fish for trout or salmon and most (81%) of those trips were usually no more than a week in length (Table 13). Thirty-two percent of anglers reported traveling no more than 50 miles to fish for trout, 36% reported traveling up to 200 miles, and the other 32% reported traveling 500 miles or more (Table 13).

When asked to rate how often they harvested trout on a five-point scale that ranged from never (1) to always (5), respondents were fairly evenly divided between those who 'never' or 'rarely' harvested trout (39%), and those who harvested trout 'often' or 'always' (34%) (Figure 3). Twenty-seven percent of anglers reported harvesting trout occasionally.

Motivations and Preferences

Motives unrelated to catching fish were ranked as important or very important reasons to fish by most anglers (Table 14). Most (≥60%) anglers rated the non-catch motives of getting outdoors, relaxing, getting away from it all, spending time with family or friends, and experiencing new things as being important or very important reasons to fish. The only non-catch motive that did not rate as important among many (43%) anglers was getting physical exercise. Catch-related motives that were ranked important or very important by most anglers included the experience of the catch, the challenge or sport of angling, and developing skills. Catch-related motives that were not ranked important by most anglers included obtaining fish to eat, catching a trophy fish, and sharing knowledge of fishing with others.

Anglers were also asked to rate their level of agreement with eleven statements related to catching and harvesting trout (Table 15). Most (60%-66%) anglers agreed or strongly agreed that the more and bigger trout they caught the better, but 69% also agreed that a trip could be successful if they caught nothing. How they caught their trout was as important to most (57%) anglers as actually catching one. Most (77%) anglers indicated that they were just as happy to release the trout they caught as keep them, and most (78%) agreed that it did not matter to them what type of trout they caught. Most (63%) anglers also wanted to fish where they had a chance at catching a trophy trout, but fewer (37%) considered catching a trophy to be the biggest reward that fishing had to offer them. Twenty-nine percent of survey respondents felt that they had to catch something to be satisfied with a fishing trip. In regards to harvesting trout, only 15% of anglers felt it was more enjoyable to keep the trout they caught than release them and 27% felt that bringing trout home to eat was an important outcome of fishing.

Management opinions

Minimum size limits and spawning area refuges were the only regulations that received support from most (69% and 60%, respectively) anglers (Table 16). Maximum size limits, slot limits, reduced creel limits, and catch-and-release areas received support from 39 to 45% of anglers. Few (20-29%) anglers supported prohibitions on the use of bait, closed

seasons, and limiting artificial lures to single-hook only tackle. Most (80-81%) respondents strongly supported management efforts to improve habitat and water quality (Table 17). Most (55-77%) anglers were also in favor of increased stocking of trout and access to the rivers.

Angler satisfaction with Tennessee's tailwater trout fisheries averaged a 3.7 on a five-point scale, where 5.0 equaled most satisfied. Anglers were evenly divided when asked if they thought the quality of the fisheries had declined, stayed the same, or improved in past five years (Figure 4).

Recreational Specialization

Cluster analysis

Plotting the cubic cluster criterion against the number of hierarchical clusters formed by two hierarchical clustering methods (Ward's and McQuitty's) suggested that there were five distinct subgroups of anglers in the total sample of survey respondents (Figure 5). Nonhierarchical cluster analysis was then used to determine the size of the clusters (Table 18). Clusters ranged in size from 178 anglers to 369 anglers. Of the 1,396 anglers that responded to the survey, only the responses from 1,341 could be used in the cluster analyses because of missing data for 55 individuals. Table 19 summarizes the data for each of the five subgroups that were formed.

Cluster 1 - This cluster was the most specialized of the five subgroups. Ninety-eight percent of the anglers in Cluster 1 ranked trout as their most preferred sportfish. Anglers in this subgroup averaged 48 d of trout angling in the previous year, which represented 89% of their fishing trips. They had been pursuing trout for an average of 21 yr, and 61% had invested between $1,001 and $5,000 in trout fishing equipment, the most of any group. Anglers in this group rarely harvested trout; 42% responded that they never harvested trout and 36% harvested trout only rarely. Trout angling was an important part of their lives: 76% claimed to have taken a vacation with the primary purpose of fishing for trout or salmon, and 49% claimed to have traveled over 500 mi to do so. Seventy-eight percent agreed that fishing was their main form of outdoor recreation. These anglers also had the highest ranking on five of the six centrality statements. This group was labeled as 'Non-consumptive Specialists'.

Cluster 2- This subgroup of anglers was unique in that it was comprised of specialized anglers, but they were not specialized trout anglers. Only 14% of anglers in this group rated trout as their most preferred sportfish, and only 36% of their fishing trips last year were spent targeting trout. Thus, trout were only of secondary interest to most of these anglers. Anglers in this group averaged 16 d of trout angling in the last year, which represented only 36% of their fishing trips, and 12 yr of trout fishing experience. Sixty percent of them had invested less than $200 in trout fishing equipment. Only 26% of them reported ever taking a vacation to fish for trout or salmon and 44% had never traveled more than 50 mi to fish for trout. Many (55%) anglers in the group reported harvesting trout 'often' or 'always'. They had moderate to high scores for the six centrality questions,

which indicated that fishing is an important activity to them. This group was labeled 'Occasional Trout Anglers'.

Cluster 3 - Anglers in this group were the least specialized at fishing in general, but still spent more time fishing for trout than anglers in cluster 2. Most (83%) of them ranked trout as their most preferred sportfish. They averaged 22 d of trout fishing in the last year out of only 30 d fishing for all species. They also averaged 12 yr of trout angling experience. Anglers in this group exhibited moderate harvesting practices. As with cluster 2, 60% of the anglers in cluster 3 had invested less than $200 in trout fishing equipment. Only 16% of them had ever taken a vacation to fish for trout or salmon, and 55% of them had traveled less than 50 miles to fish for trout. Anglers in this group had the lowest average scores on the six centrality questions. Anglers in this subgroup were labeled 'Casual Trout Anglers'.

Cluster 4 - This was the second most specialized subgroup of anglers with 88% ranking trout as their most preferred sportfish to target. Anglers in this cluster averaged 42 d of trout fishing in the last year, which represented 81% of their fishing trips. They averaged 19 yr of trout fishing experience, and 50% had invested a modest amount ($201-500) in trout fishing equipment. The group was split as to whether they had ever gone on a trout fishing vacation; 45% of them had traveled up to 200 miles to go trout fishing. This subgroup averaged moderate to high scores on the six centrality questions. Anglers in cluster 4 were much more likely to harvest trout than anglers in cluster 1; thus, they were labeled 'Consumptive Specialists'.

Cluster 5 - This was the third most specialized group. Forty-five percent of these anglers ranked trout as their preferred sportfish. They averaged 35 d of trout fishing in the last year, which represented 58% of all their fishing trips. Anglers in this group averaged 22 yr of trout fishing experience, the most of any cluster. They had the second most amount of money invested in trout fishing equipment; 57% had invested $1,001 to $5,000. Nearly half (47%) of these anglers harvested trout 'often' or 'always'. Sixty-two percent of them had gone on a trout fishing vacation and 36% of them had traveled up to 200 miles to fish for trout. They also had moderate to high average scores on the six centrality questions. The anglers in this cluster were labeled 'Fishing Generalists'.

Demographic characteristics

The mean age of anglers in each cluster varied significantly ($F = 4.19$; $df = 4$; $P = 0.002$). Casual anglers (cluster 3) were significantly younger on average than non-consumptive specialists (cluster 4) and generalists (cluster 5) (Table 20). The mean age at which anglers began fishing also varied among clusters ($F = 6.71$; $df = 4$; $P = 0.0001$). Generalists began fishing at the earliest age on average; casual anglers began fishing at the latest age on average. There were significant differences between anglers groups for both education ($\chi^2 = 140.46$; $df = 20$; $P < 0.0001$) and household income ($\chi^2 = 123.06$; $df = 20$; $P<0.0001$) (Table 20). Non-consumptive specialists were by far the most educated and wealthiest group; 59% of their anglers had at least a four-year college degree and 27% had annual household incomes over $100,000. The percentage of individuals with at least a college

degree for the other four clusters ranged from 23% to 38%, and modal annual household incomes ranged from $20,000 to $59,999.

Angling Methods

The relative frequency with which anglers used certain fishing methods varied significantly with specialization (Table 21). As angler specialization increased among angler groups, so did the use of fly fishing ($\chi^2 = 320.34$; df = 16; $P < 0.0001$). The exact opposite was the case with bait fishing, the use of which declined in relation to the increase of specialization within angler groups ($\chi^2 = 278.01$; df = 16; $P < 0.0001$). The use of artificial lures, excluding flies, was fairly constant among angler groups with the exception of the non-consumptive specialists, who rarely used them ($\chi^2 = 154.7$; df = 16; $P < 0.0001$).

Motivational differences

Large sample sizes yielded highly significant ($P \leq 0.0003$) differences among groups for most (10 of 13) of the motives examined (Table 22), even though the differences between means were sometimes as little as 0.3 points on a five-point scale. Only one of the thirteen motives was ranked similarly among the five angler groups (Table 22). The one motive for which their rankings did not differ was 'to be with friends' ($\chi^2 = 3.93$; df = 4; $P = 0.42$). The most disparate mean rankings among angler groups were for the motive 'obtaining fish to eat' which non-consumptive specialists ranked much lower than did the other four groups ($\chi^2 = 312.02$; df = 4; $P < 0.0001$). This is not a surprise since harvest frequency was one of the variables used in the cluster analysis. The two specialist groups (i.e., non-consumptive specialists and consumptive specialists) tended to rank the rest of the motives (both non-catch and catch related) higher than did the other three angler groups. Surprisingly, those two specialist groups also had identical, or nearly identical mean responses to several key motivations, including catching a trophy, experiencing the catch, and developing their fishing skills.

Catch preferences

Mean rankings for eight of the eleven catch preference statements differed among the five angler groups (Table 23). Differences among angler groups were most apparent for statements regarding the harvest of trout, which was of very little importance to the non-consumptive specialists. When asked if they were just as happy to release the trout they caught, non-consumptive specialists agreed much more strongly with the statement than did the other groups. Significant differences existed among groups for statements regarding the pursuit of trophy trout and the importance of using specific angling methods to catch trout. In both cases, the more highly specialized the group, the more they agreed with the statements. The three statements with similar rankings among groups were related to the importance to their overall satisfaction of catching numbers of trout, catching something, and the type of trout they caught.

Regulations and management practices

Angler support for fishing regulations varied substantially among angler groups; non-consumptive specialists consistently showed greater support than the other groups (Table 24). This was most apparent for regulations involving reductions in the daily creel limit, establishing catch-and-release areas, and prohibiting the use of bait or multi-hook artificial lures. The only regulation that was not supported by most anglers in any of the five groups was establishing closed fishing seasons. Most anglers in all groups supported the use of minimum length limits, and spawning refuges areas such as those on the South Fork of the Holston River.

Anglers were also asked to rate the importance of four management actions that did not involve fishing regulation, but could still be vital to improving trout angling. Each of the four management options was strongly supported by all of the angler groups (Table 24). Support for habitat and water quality improvement efforts increased with specialization. No significant difference could be found between the four groups in terms of the level of importance they assigned to increased river access. All angler groups supported stocking more trout.

Tailwater Comparisons

The proportion of anglers in each cluster varied between tailwaters ($\chi^2 = 77.4$; df = 28; $P = 0.0001$; Table 25). Consumptive specialists (cluster 4) were the single largest angler group at five of the eight rivers surveyed. The five rivers were the Caney Fork (27% of all anglers), Clinch (25%), Elk (28%), South Fork of the Holston (35%), and Watauga (35%). On the Duck, Hiwassee, and Obey Rivers, consumptive specialists were the second largest group. On the Duck and the Obey Rivers, the largest angler group was occasional trout anglers (cluster 2). The largest group on the Hiwassee River was non-consumptive specialists (cluster 1). Fishing generalists (cluster 5) were the smallest or second smallest group on each river.

Harvest frequencies varied only slightly among tailwaters with the exception of the Obey River, where 67% of anglers reported harvesting trout 'often' or 'always' ($\chi^2 = 123.9$; df = 28; $P = 0.0001$) (Figure 6). The next highest harvest frequencies (36%) were reported by anglers on the Caney Fork and Elk Rivers. The lowest harvest frequencies were reported on the South Holston and Watauga Rivers where about half (47-52%) of anglers reported harvesting trout 'rarely' or 'never'.

Mean scores for the eleven catch preference statements differed very little among the tailwaters and statewide with a few exceptions (Table 26). Compared to anglers elsewhere, anglers on the Obey were much more likely to agree that they preferred to keep their catch rather than release their catch ($\chi^2 = 40.8$; df = 7; $P = 0.0001$) and that bringing trout home to eat was an important outcome of fishing ($\chi^2 = 45.5$; df = 7; $P = 0.0001$). Obey River anglers were also much less likely to agree with the statement that they were just as happy to release the trout they caught ($\chi^2 = 57.3$; df = 7; $P = 0.0001$). The strong

preference of Obey River anglers to harvest trout was not a surprise; 67% of anglers interviewed on the Obey River reported harvesting trout 'often' or 'always'.

Mean rankings for each of the nine fishing regulations presented to anglers differed significantly among the eight tailwaters (Table 27). Despite high support for minimum size limits across the state, support still differed significantly among tailwaters ($\chi^2 = 18.7$; df = 7; $P = 0.009$), as was the case with spawning refuges ($\chi^2 = 21.3$; df = 7; $P = 0.003$). Support for maximum size limits ($\chi^2 = 17.2$; df = 7; $P = 0.02$) and slot limits ($\chi^2 = 28.2$; df = 7; $P = 0.0002$) was high on the Caney Fork and South Fork of the Holston Rivers but only moderate elsewhere. Support for reducing the daily creel limit was high on the Watauga River, low on the Obey River, and moderate on the other tailwaters ($\chi^2 = 48.9$; df = 7; $P = 0.0001$). Restrictions on the use of bait and multi-hook artificial lures received little support across the entire state, and the same was true for closed seasons. Support for catch-and-release areas varied considerably ($\chi^2 = 51.5$; df = 7; $P = 0.0001$), receiving strong support on the Caney Fork, Duck, Elk, Hiwassee, and Watauga Rivers, but only low or moderate support elsewhere.

In addition to regulations, anglers were also asked to rank the importance of four other types of management actions to improve trout angling. Habitat and water quality improvements received strong support across the state, but improvements in water quality received especially high support from anglers on the Duck River ($\chi^2 = 19.4$; df = 7; $P = 0.007$; Table 27). This strong support is likely due to the fact that trout stocking is often suspended in the late summer and early fall because of high water temperatures and low dissolved oxygen. Increasing access to the rivers received high support across the state, but received particularly high support on the South Fork of the Holston and Watauga Rivers ($\chi^2 = 14.2$; df = 7; $P = 0.05$). Stocking of more trout received the same level of support across the state ($\chi^2 = 7.8$; df = 7; $P = 0.35$).

Size and Number Preferences

Hypothetical catch scenarios were presented to 1,093 anglers across the state and 2,186 responses were received (two scenarios were presented to each angler). Mean satisfaction responses on a five-point scale ranged from a low of 1.79 for the "one 203-mm trout" scenario to a high of 4.78 for the "seven 356-mm trout" scenario (Table 28). Response variation was high across all of the catch scenarios, but was the lowest for the scenarios involving multiple trout of 305 and 356 mm.

Trout size, as opposed to the number caught, had the greatest influence on angler satisfaction. For each size class, mean satisfaction responses increased 0.65-1.22 units (on the five-point scale) as the catch increased from 1 to 7 trout. However, mean satisfaction responses increased by 1.98-2.34 units across the different trout sizes for each of the catch-in-number categories. Categorical modeling with weighted least-squares analysis revealed that the size and number of trout in a catch scenario had a significant influence on angler satisfaction (Table 29). However, the chi-square statistic was approximately four times higher for the size effect than for the number effect, indicating that anglers derived more satisfaction from catching larger trout than simply catching more trout.

Angler satisfaction pertaining to current fishing conditions varied greatly ($\chi^2 = 182.7$; df = 28; $P = 0.0001$). Mean angler satisfaction with current trout fishing conditions ranged from a low of 2.5 on the Hiwassee River to a high of 4.1 on the South Fork of the Holston River (Table 30). The other six tailwater rivers received mean rankings ranging from 3.1 to 3.7 (Table 30).

DISCUSSION

Survey Bias

The first thing that must be addressed when discussing the results of any study are potential sources of bias. The two primary sources of bias in a mail survey are recall bias and nonresponse bias (Brown 1991; Tarrant et al. 1993). Recall bias results from inaccurate recollection of certain events by an interviewed subject. Nonresponse bias is when the answers of respondents differ significantly from the answers that would have been given by nonrespondents. In extreme cases, both can cause researchers to draw inaccurate conclusions about surveyed population.

Recall bias is often a problem when examining an individual's frequency of participation in an activity, but is rarely a problem when examining attitudes and opinions. One study of recall bias examined frequency of participation among the membership of a local swimming pool (Chase and Harade 1984). Members were asked to recall the number of times they had visited the pool in the past year, and their responses were compared to the pools records. The study found that survey respondents overestimated their use of the facility by an average of 15 trips. Other studies have indicated similar overestimation of data when asking anglers to recall the number of fishing trips they had made over a period of time (Tarrant et al. 1993).

Researchers have concluded that the only ways to mitigate recall bias are to use a diary survey, where anglers keep a log of their angling activities over a period of time, or to shorten recall periods to as little as two months (Brown 1977). Both of the above methods have their shortcomings. Diary surveys ask more involvement on the angler's part than a one-time survey which can lead to lower response rates. Shortened recall periods can provide misleading data because anglers often fish more frequently at different times of the year than others. Estimating angling frequency was not a primary objective of this study; therefore, a longer recall period of one year was used in this study.

Unlike recall bias, nonresponse bias can have a significant effect on virtually all survey variables. Mail surveys often have low response rates, which make them susceptible to nonresponse bias (Brown 1991). Other mail surveys of anglers have had response rates that ranged from 50 to 80%, which is considered to be high for the average mail survey (Chipman and Helfrich 1988; Fisher 1996; Romberg 1999). This study's response rate was 55%. Chipman and Helfrich's (1988) study focused on smallmouth bass anglers on two rivers in Virginia and had a high (80%) response rate. Chipman and Helfrich interviewed anglers on the rivers and later sent them a mail survey. Fisher (1996) and

Romberg (1999) both conducted statewide mail surveys of anglers. Fisher's study examined both freshwater and marine anglers in Texas and had a response rate of 62%. Romberg (1999) surveyed non-resident anglers that fished in the state of Alaska and had a response rate of 55%. Both Fisher (1996) and Romberg (1999) obtained their sample of anglers from lists of license holders. Cleveland (1995) had a 79% response rate for his mail survey of Sportsman license holders in Tennessee while this study's mail survey had a 75% response rate.

Comparisons between respondents and nonrespondents for mean age, years of experience, highest level of education, and household income showed that there were significant differences between the two groups in this study. Stepwise logistic regression chose the on-site survey variables age, angling method, and highest level of education as making the best model to explain an anglers probability of responding to the mail survey. Fisher (1996) also found age to be a significant indicator of response probability, but he did not have access to data on the angler's level of education or preferred angling methods. Similar to Fisher's study, we found that the adjusted mean for years of angling experience was significantly different from the unadjusted survey mean, but did not detect a difference in frequency of angling participation. It is likely that differences in the latter could not be detected in both studies because the natural variability in angler participation rates was much greater than the variability introduced by nonresponse bias.

Unlike Fisher's (1996) study, we found significant differences between adjusted and unadjusted mean scores for motive, catch preference, and management opinion questions. Fisher concluded that an angler's age was not related to their motives and attitudes because he found no significant difference in their adjusted and unadjusted means. If Fisher's conclusion is accurate, our findings would suggest that an anglers attitudes and opinions are more likely influenced, or better predicted, by their level of education and angling methods. It is our conclusion that education and angling method are good predictors of response because of their relationship to angler specialization. In this study, specialized groups of anglers tended to have higher levels of education and were more likely to fish with artificial lures than with bait, and the case was the same for survey respondents. It is widely accepted that the more salient the subject of a survey is to an individual, the more likely they will be to take the time to participate (Dillman 1978; Fisher 1996). A logical extension of this is that specialized anglers are more likely to participate in a survey than unspecialized anglers. Despite the apparent sources of nonresponse bias in this study, they should have been minimized by the adjustments we made to the survey means using response propensity stratification.

Survey Findings

The trout anglers targeted in this study were a diverse group of individuals that spanned the socioeconomic spectrum and they had a wide range of attitudes and desires pertaining to the resource. The cluster analysis revealed five groups of trout anglers that shared some similarities to one another yet possessed differences that are relevant to the management of the resource. The results of this study mirror the results of previous studies elsewhere (Chipman and Helfrich 1988; Fisher 1997; Romberg 1999) which have identified several angler subgroups that ranged from the low to the high end of the specialization continuum

outlined by Bryan (1977). These studies typically identified one or two highly specialized sub-groups whose anglers placed greater emphasis on the catch-related attributes of the angling experience, with specific interest in catching large or trophy fish and less interest in harvesting fish. Those studies also identified several subgroups of lesser specialization whose anglers emphasized non-catch related motives related to relaxation and family recreation as being primary reasons for angling while at the same time being likely to harvest the fish they catch. The results of this study tended to follow the same pattern.

Primary sources of motivation differed significantly among the five trout angler subgroups outlined in this study. Anglers in the more specialized groups (consumptive and non-consumptive anglers, fishing generalists) tended to place greater emphasis on catch-related motives for angling. They were more interested in pursuing trophy trout and being challenged by the sport than their less specialized counterparts. In addition, specialized anglers were more interested in testing their angling skills and sharing their knowledge of the sport with other anglers than were the less specialized angler groups. This difference was likely due to the fact that less specialized anglers were still in the process of developing their skills and they may have felt that they had less knowledge to share with other anglers. All anglers tended to rank the non-catch related motives fairly equally. However, the anglers in the less specialized subgroups (occasional and casual trout anglers) tended to consider non-catch related motives more important than the catch related motives.

When asked about their catch preferences, all the angler subgroups agreed that catching more and bigger fish increased their satisfaction. Anglers presented with hypothetical catch scenarios indicated that the size of the trout they caught had more to do with their perceived satisfaction than the number of trout they caught. Petering et al. (1995) observed the same results for crappie anglers in Ohio. However, most anglers in the present study agreed that catching a trout was not necessary to have a satisfactory fishing trip. These seemingly contradictory results likely stem from a matter of practicality. If an individual cannot tolerate going “fishless” from time to time, they probably will not last in the sport for long. Angler subgroups began to differ in opinion when it came to the importance of having trophy trout fisheries, which were ranked significantly higher by the more specialized subgroups. Previous studies have also found specialized anglers to put greater emphasis on having the opportunity to catch trophy fish (Chipman and Helfrich 1988; Fisher 1997; Romberg 1999).

Not surprisingly, an area of particular contention between angler subgroups was whether or not to harvest trout. The five subgroups differed significantly for all motive and catch preference questions related to the importance of harvesting or releasing trout. Group 1 (the nonconsumptive specialists) was the subgroup with the least interest in harvesting trout, and showed the greatest support for practicing catch-and-release. Conversely, groups 2 and 5 (the occasional trout anglers and fishing generalists) were the subgroups most likely to harvest trout they caught, and they placed the greatest emphasis on the importance of harvesting trout to their angling satisfaction. They also spent the smallest percentage of their total fishing trips targeting trout.

Bryan (1977) observed that as an angler's level of specialization increased, so too did their interest in preserving the resource, which lead to the adoption of catch-and-release practices. This has been supported by studies of other angler populations (Chipman and Helfrich 1988; Romberg 1999). As a result, this study chose to use frequency of harvest as one of its measures of specialization. This decision was also precipitated by the fact that regulations pertaining to the harvest of trout have been a contentious issue in Tennessee.

Bryan (1977) also observed that as the level of specialization increased among trout anglers, so too did their use of fly fishing techniques over bait fishing. However, unlike his observations about harvest practices, Bryan's conclusions on the apparent connection between specialization and preferred angling technique were not always supported by subsequent studies. Chipman and Helfrich (1988) found no correlation between angling technique and other variables pertaining to smallmouth bass anglers use of the resource and omitted it from any further analysis of angler specialization. Angling technique was not used as a measure of specialization in this study due to the conflicting results of previous studies. However, after assigning anglers to specialization subgroups, a significant relationship was found between specialization and the relative frequency with which anglers used different angling techniques. Fly fishing was used with significantly greater frequency among the more specialized subgroups; whereas, bait fishing was more commonly used by the less specialized subgroups. This supported Bryan's observations of trout anglers in the western United States. It is possible that Chipman and Helfrich (1988) did not come to this conclusion because their study focused primarily on smallmouth bass anglers. Fly fishing is not as common among bass anglers, perhaps due to the fact that it is banned in most bass fishing tournaments, which in recent decades have become the driving force behind the innovation of bass fishing techniques.

Tennessee trout angler subgroups with high levels of specialization showed greater support for management regulations than subgroups with low specialization, supporting the results of previous research (Chipman and Helfrich 1988; Romberg 1999). This is not surprising given the differences in motives, catch and harvest preferences, and angling techniques between anglers with low versus high levels of specialization. Less specialized anglers tended to harvest trout more frequently, fished with bait, and placed little emphasis on catching trophy trout. As such, it is not surprising that less specialized anglers opposed trout-trout regulations that limited their harvest and restricted them from using their preferred angling. Conversely, this study also found that the more specialized anglers did not oppose trophy-trout regulations that limited the harvest of trout or fishing with bait, two things they were less likely to do anyway. This illustrates the point that an angler's opinions on how a fishery should be managed are not decided arbitrarily, but are a logical extension of that angler's fishing preferences and behaviors. These observations explain the key differences in the management opinions of the five angler subgroups and the anglers utilizing the eight tailwaters across the state.

MANAGEMENT IMPLICATIONS

Differences in the attitudes and opinions of the five trout angler subgroups can, and have, lead to conflict between the various groups over how a given trout fishery should be managed. Dealing with these conflicts can be difficult. One approach is to seek a compromise that appeals to the desires of different angler groups. The use of slot limits is a good example. Slot limits protect larger trout to increase the number of trophy fish, while still allowing the harvest of more numerous, smaller trout. Ideally, this should provide a good compromise between those that wish to harvest trout, and those that want to increase their chance of catching a trophy. However, such compromises do not always work. When a compromise cannot be reached, managers may find themselves in the difficult position of having to make a unilateral decision. When in this position, the manager should consider the concept of substitutability.

The concept of substitutability states that the more specific an individual's motives, preferences, and desires, the less substitutable are the experiences required to meet those desires (Hendee and Burdge 1974; Bryan 1982). Individuals with specific needs have fewer resources available to meet those needs than do individuals with very general needs. Managers should remember that the more specialized the individual the more specific their preferences and needs. This suggests that when resource managers are faced with limited resources, they should side with individuals who's preferences dictate that their satisfaction is most closely tied to those resources, while steering individuals with more general preferences to other available resources in the area that will meet their needs.

Decisions of this nature can be controversial and require great care, but when made properly are often in everyone's best interest. In the current study, angler groups 2 and 5 (the occasional trout anglers and fishing generalists, respectively) are probably the most substitutable groups due to the fact that the majority of anglers within these two subgroups did not rank trout as their most preferred species of fish to pursue. Anglers within groups 1 and 4 (the non-consumptive and consumptive specialists, respectively) would be the least substitutable because they spent an average of 80 to 90% of their fishing trips targeting trout. It is important to determine whose recreational satisfaction depends the most on the resource in question.

Fisheries managers can best allocate resources by reviewing the motives and preferences of the five angler subgroups, and keeping in mind which subgroups dominate the angler constituencies of each of the eight rivers. The Caney Fork, Clinch, and Hiwassee Rivers had the most uniform distributions of anglers among the five subgroups and the potential for conflicts over management decisions will be relatively high. Managers will have a diverse clientele to satisfy and may have to resort to steering less specialized anglers to other fisheries in the area or maintaining the status quo. The Duck River and the Obey River fisheries were dominated by the less specialized subgroups (the occasional and casual trout anglers and fishing generalists); thus, the current put-and-take management strategy on those two systems is likely meeting their needs. Finally, the fisheries on the Elk, South Fork of the Holston, and Watauga Rivers were dominated by the most

specialized subgroups (consumptive specialists and non-consumptive specialists), suggesting that more specialized regulations would be or are accepted by the majority of anglers on those rivers. The Watauga River already has special regulations in the form of a Quality Zone, where bait is prohibited and the minimum size is 356-mm. On the South Fork of the Holston River, a protected slot (406 – 559 mm; only one fish over the slot per day) is in effect and two spawning refuges are on the river. Anglers on these two rivers expressed greater support for most of the nine regulations listed in the mail survey than did anglers on the other six tailwaters.

When there are several management alternatives and the resources is protected regardless of which alternative is chosen, it is best to bring interest groups together in a format that allows them to share in the decision making process with biologists serving as information providers. Advisory committees consisting of biologists and representatives of interested angler groups can work together to develop management plans that take into account the needs of all those involved while reducing excessive conflict over management decisions (McMullin 1996).

ACKNOWLEDGMENTS

We would like to thank Dr. Steve McMullin of Virginia Tech for his input on the design of this survey; without his help our task would have been much more difficult. Drs. Michael Allen, Ada Haynes, and Gene Wilde contributed valuable insight into the analyses and interpretation of human dimensions data. Jeff Williams conducted a concurrent study and provided much of the information reported in this report and his dedication to the success of this project is much appreciated. Finally, we thank the legions of creel clerks who dutifully traveled throughout the State to conduct and record the on-site interviews.

Primary funding for this research was provided by the Tennessee Wildlife Resources Agency. Additional funds were provided by the Center for the Management, Utilization, and Protection of Water Resources at Tennessee Technological University and the Tennessee Cooperative Fishery Research Unit.

REFERENCES

Agresti, A. 1990. Categorical data analysis. John Wiley and Sons, New York.

Alderderfer, M. S., and R. K. Blashfield. 1984. Cluster analysis. Sage publications. Newbury Park, California.

Bettoli, P. W., and L. Bohm. 1997. Interim report and summary of project activities: Clinch River trout investigation and creel survey. Fisheries Report 97-39, Tennessee Wildlife Resources Agency, Nashville.

Bettoli, P. W., S. J. Owens, and M. Nemeth. 1999. Trout habitat, reproduction, survival, and growth in the South Fork of the Holston River. Fisheries Report 99-3, Tennessee Wildlife Resources Agency, Nashville.

Brown, T. L. 1977. Economic impact of New York's Great Lakes sport fisheries. Journal of Great Lakes Research 3:164-166.

Brown, T. L. 1991. Use and abuse of mail surveys in fisheries management. American Fisheries Society Symposium 12:255-261.

Bryan, H. 1976. The sociology of fishing: a review and critique. Pages 83-92 *in* H. Clepper, editor. Marine recreational fisheries. Sport Fishing Institute, Washington,

Bryan, H. 1977. Leisure value systems and recreational specialization: the case of trout fishermen. Journal of Leisure Research 9:174-187.

Bryan, H. 1979. Conflict in the great outdoors. University of Alabama, Bureau of Public Administration, Sociological Studies 4, Tuscaloosa.

Bryan, H. 1980. Impact of professional bass tournaments on orientation to fishing and disposition of fish. Report to the Sport Fishing Institute, Washington,D.C.

Bryan, H. 1982. A social science perspective for managing recreational conflict. Pages15-22 *in* R. H. Stroud, editor. Marine recreational fisheries. Sport Fishing Institute, Washington, D.C.

Chase, D. R., and M. Harada. 1984. Response error in self-reported recreation participation. Journal of Leisure Research 16:322-329.

Chipman, B. D. 1986. Recreational specialization as an indicator of attitudes and management preferences of Virginia river anglers. Master's thesis. Virginia Polytechnic Institute and State University, Blacksburg.

Chipman, B.D., and L. A. Helfrich. 1988. Recreational specializations and motivations of Virginia river anglers. North American Journal of Fisheries Management 8:390-398.

Cleveland, T. A. 1995. Angler survey of Tennessee sportsman license holders. Master's t thesis. Tennessee Technological University, Cookeville.

Devlin, G., and P. W. Bettoli. 1999. Creel survey and population dynamics of salmonids stocked into the Caney Fork River below Center Hill Dam. Fisheries Report 99-8, Tennessee Wildlife Resources Agency, Nashville.

Dillman, D. A. 1978. Mail and telephone surveys: the total design method. Wiley-Interscience, New York.

Ditton, R. B. 1977. Human perspectives in optimum sustainable yield fisheries management. Marine Recreational Fisheries 2:29-41.

Fisher, M. R. 1996. Estimating the effect of nonresponse bias on angler surveys. Transactions of the American Fisheries Society 125:118-126.

Fisher, M. R. 1997. Segmentation of the angler population by catch preference, participation, and experience: a management-oriented application of recreational specialization. North American Journal of Fisheries Management 17:1-10.

Graefe, A. R. 1980. The relationship between level of participation and selected aspects of specialization in recreational fishing. Doctoral dissertation. Texas A&M University, College Station.

Hendee, J. C. 1974. A multiple-satisfaction approach to game management. Wildlife Society Bulletin 2:104-113.

Hendee, J. C., and H. Bryan. 1978. Social benefits of fish and wildlife conservation. Proceedings of the Annual Meeting Western Association of Fish and Wildlife Agencies 58:234-254.

Hendee, J. D., and R. J. Burdge. 1974. The substitutability concept: implications for recreational research and management. Journal of Leisure Research 6:157-162.

Kuentzel, W. F., and C. D. McDonald. 1992. Differential effects of past experience, commitment, and lifestyle dimensions on river use specialization. Journal of Leisure Research 24:269-287.

Little, R. J. 1986. Survey nonresponse adjustments for estimates of means. International Statistical Review 54:139-157.

McFadden, J. G. 1969. Trends in freshwater sport fisheries of North America. Transactions of the American Fisheries Society 98:136-150.

McMullin, S. L. 1996. Natural resource management and leadership in public arena decision making: a prescriptive framework. American Fisheries Society Symposium 16:54-63.

Milligan, G. W. 1980. An examination of the effects of six types of error perturbation on fifteen clustering algorithms. Psychometrika 45:325-342.

Nielsen, L. A. 1993. History of inland fisheries management in North America. Pages 3-31 *in* C. C. Kohler and W. A. Hubert editors. Inland Fisheries Management in North America. American Fisheries Society, Bethesda, Maryland.

Petering, R. W., G. L. Isbell, and R. L. Miller. 1995. A survey method for determining angler preferences for catches of various fish length and number combinations. North American Journal of Fisheries Management 15:732-735.

Roedel, P. M., editor. 1975. Optimum sustainable yield as a concept in fisheries management. American Fisheries Society Special Publication 9.

Romberg, W. J. 1999. Market segmentation, preferences, and management attitudes of Alaska nonresident anglers. Master's thesis. Virginia Polytechnic Institute and State University, Blacksburg.

SAS Institute. 1988. SAS/STAT user's guide, release 6.03 edition. SAS Institute, Cary, North Carolina.

Summerfelt, R. C. 1999. Lake and reservoir habitat management. Pages 285-320 31 *in* C. C. Kohler and W. A. Hubert editors. Inland Fisheries Management in North America, Second Edition. American Fisheries Society, Bethesda, Maryland.

Tarrant, M. A., M. J. Manfredo, P. B. Bayley, and R. Hess. 1993. Effects of recall bias and nonresponse bias on self-reported estimates of angling participation. North American Journal of Fisheries Management 13:217-222.

Tennessee Wildlife Resources Agency. 2002. Management plan for the Norris tailwater trout fishery 2002-2006. Tennessee Wildlife Resources Agency, Nashville.

U.S. Department of Interior, Fish and Wildlife Service and U.S. Department of Commerce, Bureau of the Census. 1991 National Survey of Fishing, Hunting, and Wildlife-Associated Recreation, Tennessee. U.S. Government Printing Office.

Wellman, J. D., J. W. Roggenbuck, and A. C. Smith. 1982. Recreational specialization and norms of depreciative behavior among canoeists. Journal of Leisure Research 14:323-340.

Table 1. Onsite survey variables used as dependent variables in logistic regression analysis to generate response probabilities for nonresponse bias analysis. Asterisks mark the variables that were selected for the model by SAS.

Onsite survey variables
Angling behavior
Fishing method (artificials versus bait)*
Primary purpose of trip
Angling frequency on tailwater
Distance driven to tailwater (mi)
Time spent in transport
Total trip expenditures
Years of trout angling experience
Demographic
State residence status (resident or nonresident)
Gender
Age (Years)*
Marital status
Annual household income
Education*

Table 2. Dimensions and associated survey items used in the cluster analysis that divided survey respondents into subgroups based on the concept of recreational specialization. Item number refers to the question in the mail survey that was used to obtain the item. A copy of the mail survey is found in Appendix B.

Dimension and Item	Item number
Resource Use	
Species preference	4
Percent angling effort targeting trout	7,8
Harvest frequency	30
Experience	
Frequency of trout fishing	8
Years of trout fishing experience	10
Investment	
Monetary investment in trout fishing equipment	16
Centrality	
Length of trout/salmon fishing vacations	17, 17a
Maximum distance traveled to fish for trout or salmon	18
Agreement with 6 centrality statements	21 a, b, e-h

Table 3. Sample distribution (%) of hypothetical size-number catch scenarios based on the variability of responses received during a pilot-study conducted on the Caney Fork and Obey Rivers, June 2001.

	Total length (mm)				
Number	203	254	305	356	Total
1	8.53	4.32	11.62	3.41	27.88
3	8.53	4.96	4.54	5.62	23.64
5	8.64	7.63	5.62	6.06	27.95
7	1.63	4.96	5.87	8.06	20.52
Total	27.33	21.87	27.65	23.15	100

Table 4. Means and frequency of responses to on-site survey questions for the entire sample of trout anglers, respondents, and nonrespondents. Anglers with non-deliverable questionnaires were included with nonrespondents.

Variable	Entire sample (N =2,664)	Respondents (N = 1,396)	Nonrespondents (N = 1,268)
Age (Years)	43.9	45.1	42.5
Experience (Years)	17.0	18.1	15.8
Angling method (%)			
Artificial	32.4	36.6	27.9
Bait	67.6	63.4	72.1
Gender (%)			
Male	95.9	95.3	96.4
Female	4.1	4.7	3.6
Education (%)			
Some grade school	0.9	0.8	0.9
Grade school	0.7	0.5	0.9
Some high school	14.2	9.8	18.9
High school	34.6	29.7	39.9
Vo-Tech degree	3.4	4.1	2.6
Some college	18.0	19.8	16.2
College degree	20.6	25.2	15.7
Graduate degree	7.6	10.0	5.0
Income (%)			
Less than $20,000	14.6	11.8	17.7
$20,000 – 39,999	27.3	24.4	30.6
$40,000 – 59,999	26.5	26.3	26.7
$60,000 – 79,999	15.0	17.0	12.8
$80,000 – 99,999	7.5	8.9	5.9
$100,000 or more	9.1	11.5	6.3

Table 5. Results of logistic regression analysis to calculate response probabilities. Parameter estimates of 0.0 are for variables not chosen for the model.

Parameter	Estimate	Chi-square	P
Intercept	-1.7582	105.88	0.0001
Education	0.2291	83.61	0.0001
Age	0.0130	16.76	0.0001
Angling method	0.1744	6.39	0.0115
Purpose of trip	0.0	0.15	0.6944
Fishing frequency	0.0	2.60	0.1067
Residence status	0.0	0.28	0.5969
Miles traveled	0.0	0.04	0.8483
Time traveled	0.0	0.38	0.5358
Trip expenditures	0.0	0.06	0.7998
Gender	0.0	0.68	0.4092
Marital status	0.0	0.06	0.8093
Income	0.0	3.64	0.0565
Years of trout angling experience	0.0	3.34	0.0675
Percent concordance	62.8		

Table 6. State of residence reported by survey respondents, N = 1,396.

State	Frequency	Percent
Alabama	25	1.8
Colorado	1	0.1
Florida	8	0.6
Georgia	18	1.3
Indiana	13	0.9
Kentucky	17	1.2
Louisiana	1	0.1
Massachusetts	2	0.1
Michigan	1	0.1
Minnesota	1	0.1
Missouri	1	0.1
North Carolina	31	2.2
New York	1	0.1
Ohio	14	1.0
Oklahoma	2	0.1
Pennsylvania	1	0.1
South Carolina	8	0.6
Tennessee	1206	86.4
Texas	2	0.1
Virginia	41	2.9
West Virginia	2	0.1

Table 7. Population size of areas currently occupied by survey respondents, N=1,350.

Population size	Frequency	Percent
A city of 1,000,000 or more people	90	6.7
A city of 250,000 to 999,999 people	173	12.8
A city of 50,000 to 249,999 people	270	20.0
A city or town of less than 50,000 people	407	30.1
A rural area	410	30.4

Table 8. Frequency and percentage of respondents that ranked trout as their first, second, or third most preferred sportfish, or unranked, N = 1,385.

Rank	Frequency	Percent
First	951	68.7
Second	204	14.7
Third	86	6.2
Unranked	144	10.4

Table 9. Unadjusted and adjusted means for angling frequency and years of angling experience for all fish and specifically for trout. Confidence intervals (95%) for unadjusted means reported in parentheses. Asterisks indicate adjusted means significantly different from the unadjusted mean.

Variable	Unadjusted Mean	Adjusted Mean
Angling frequency (d)	48.54 (2.77)	47.12
Trout angling frequency (d)	33.06 (2.30)	31.57
Years angling	31.38 (0.81)	28.80*
Years trout angling	17.09 (0.74)	15.54*

Table 10. Frequency of use (%) for three types of angling method as reported by survey respondents, N = 1,396.

Angling Method	Never	Rarely	Occasionally	Often	Always
Fly fishing	39.2	13.7	14.3	13.2	19.7
Artificial lures & spinning gear	21.1	11.3	24.5	31.6	11.4
Bait fishing	24.2	9.1	13.1	31.9	21.8

Table 11. Respondent self-ratings of their level of skill as trout anglers, N = 1,378.

Skill level	Frequency	Percent
Beginner	164	11.9
Somewhat experienced	467	33.9
Experienced	639	46.4
Expert	108	7.8

Table 12. Angler monetary investment in trout fishing equipment, N = 1,386.

Money Invested	Frequency	Percent
$200 or less	378	27.3
$201-500	392	28.3
$501-1000	274	19.8
$1,001-5,000	258	18.6
$5,001-15,000	64	4.6
$15,000 or more	20	1.4

Table 13. Frequency of respondents who took vacations specifically to fish for trout or salmon, length of those vacations, and maximum distance traveled.

Variable	Frequency	Percent
Vacation (N = 1,367)		
Yes	608	44.5
No	759	55.5
If yes, length (N = 609)		
1 to 3 days	266	43.7
4 to 7 days	224	36.8
7 to 10 days	83	13.6
More than 10 days	36	5.9
Maximum distance (N = 1,369)		
0 to 50 miles	436	31.8
51 to 200 miles	495	36.2
201 to 500 miles	171	12.5
More than 500 miles	267	19.5

Table 14. Level of importance (%) assigned by survey respondents to 14 potential motives for fishing (N = 1,396). Means were adjusted for nonresponse bias.

	Value*					
Motive	1	2	3	4	5	Mean ± SE
To be outdoors	3.3	0.8	3.8	28.2	64.0	4.2 ± 0.03
For family recreation	6.3	8.6	24.8	35.4	25.0	3.4 ± 0.03
To experience new things	5.1	8.4	28.8	37.1	20.6	3.3 ± 0.03
For relaxation	3.1	0.9	4.4	27.7	64.0	4.2 ± 0.03
To obtain fish for eating	23.5	18.2	27.9	18.9	11.6	2.6 ± 0.03
For the experience of the catch	2.9	2.1	10.2	36.5	48.3	4.0 ± 0.03
To be with friends	4.3	7.9	21.9	38.8	27.0	3.5 ± 0.03
To develop my skills	4.3	7.2	22.9	38.2	27.4	3.5 ± 0.03
To get away from the routine and other people	3.5	3.5	14.4	29.5	49.0	3.9 ± 0.03
To catch a trophy fish	11.2	15.6	29.7	20.6	22.9	3.1 ± 0.03
For the challenge or sport	3.5	3.8	14.2	39.7	38.8	3.8 ± 0.03
To share my knowledge of fishing with others	9.0	13.4	38.7	26.8	12.0	3.0 ± 0.03
For physical exercise	9.3	13.8	35.2	26.7	15.0	3.0 ± 0.03

*1 = very unimportant, 2 = unimportant, 3 = neutral, 4 = important, 5 = very important

Table 15. Percentage of agreement or disagreement by survey respondents with eleven statements about catching and harvesting trout (N = 1,396). Means were adjusted for nonresponse bias.

Statement	Value*					Mean ± SE
	1	2	3	4	5	
The more trout I catch, the happier I am	4.6	12.0	22.2	39.9	21.3	3.4 ± 0.03
Keeping the trout I catch is more enjoyable than releasing them	34.4	26.3	24.2	9.9	5.2	2.2 ± 0.03
The bigger the trout I catch, the better the fishing trip	4.6	9.4	20.2	35.3	30.5	3.6 ± 0.03
A fishing trip can be a success even if I catch no trout	4.9	9.6	16.2	46.5	22.8	3.5 ± 0.03
Catching a trophy trout is the biggest reward for me	9.6	21.3	32.3	19.6	17.2	3.0 ± 0.03
When I go fishing, I am not satisfied unless I catch something	15.6	30.9	24.7	19.0	9.7	2.6 ± 0.03
Bringing trout home to eat is an important outcome of fishing	27.1	22.7	24.1	18.5	7.6	2.5 ± 0.03
How I catch trout is as important to me as actually catching one	4.7	12.1	26.5	35.9	20.7	3.3 ± 0.03
I am just as happy if I release the trout I catch	2.6	6.7	13.9	35.8	41.1	3.8 ± 0.03
I like to fish where I know I have a chance to catch a trophy trout	4.3	8.8	24.2	32.7	30.1	3.6 ± 0.03
It does not matter to me what type of trout I catch	1.6	5.5	15.1	48.8	29.0	3.8 ± 0.03

*1 = strongly disagree; 2 = disagree; 3 = neutral; 4 = agree; 5 = strongly agree

Table 16. Percentage of angler support or opposition to management regulations that could be implemented on Tennessee's tailwater, trout fisheries (N = 1,396). The percentages do not add up to 100%, because some individuals gave answers of 'Don't know'. Means were adjusted for nonresponse bias.

	Value*					
Management regulation	1	2	3	4	5	Mean ± SE
Minimum size limit	5.3	7.9	13.6	32.0	37.4	3.5 ± 0.03
Maximum size limit	13.3	19.2	18.6	19.0	24.6	2.8 ± 0.03
Slot limit	11.0	17.5	23.7	23.2	17.2	2.8 ± 0.03
Reduced daily creel limits	16.3	22.3	19.6	17.9	20.7	2.7 ± 0.03
Prohibiting the use of bait	39.3	25.2	14.1	5.3	14.2	2.0 ± 0.03
Limit lures to single-hook artificials only	27.8	23.4	16.7	11.1	18.1	2.4 ± 0.03
Catch and release only areas	17.5	16.3	16.5	18.4	27.1	2.8 ± 0.03
Closed seasons	35.1	26.1	15.7	11.2	8.3	2.0 ± 0.03
Spawning refuge areas	8.9	9.2	17.4	27.7	31.9	3.3 ± 0.03

*1 = strongly oppose; 2 = oppose; 3 = neutral; 4 = support; 5 = strongly support

Table 17. Level of importance (%) assigned by survey respondents to four types of management actions that could be used to improve Tennessee's tailwater trout fisheries (N = 1,396). Means were adjusted for nonresponse bias.

	Value*					
Management option	1	2	3	4	5	Mean ± SE
Habitat improvement	8.5	2.4	9.0	23.0	57.0	3.9 ± 0.03
Water quality improvement	8.3	2.0	9.0	19.2	61.6	3.9 ± 0.03
Increased access to rivers	11.8	12.1	21.4	23.4	31.2	3.3 ± 0.03
Increased stocking of trout	7.3	2.0	13.7	27.9	49.1	3.9 ± 0.03

*1 = very unimportant, 2 = unimportant, 3 = neutral, 4 = important, 5 = very important

Table 18. Number and percent of survey respondents in each of the five trout angler subgroups as determined by cluster analysis.

Angler Group	Number of Respondents	Percent of Sample
Non-consumptive specialists	259	19.3
Occasional trout anglers	253	18.9
Casual trout anglers	282	21.0
Consumptive specialists	369	27.5
Fishing Generalists	178	13.3
Total	1341	100.0

Table 19. Means (SE) or percentages of the 14 cluster analysis variables for each of the five trout angler subgroups.

	Angler Group				
Cluster Variable	1	2	3	4	5
Resource use					
Trout preference (%)					
First	97.7	13.8	82.6	88.1	44.9
Second	2.3	27.3	14.5	10.3	26.4
Third	0.0	25.7	1.4	0.0	6.2
Unranked	0.0	30.4	1.4	1.6	19.7
Harvest frequency[1]	1.8 (0.06)	3.8 (0.12)	3.0 (0.06)	3.1 (0.05)	3.3 (0.08)
Targeted Effort[2]	89.0 (0.24)	36.3 (0.32)	78.3 (0.30)	81.1 (0.24)	58.0 (0.39)
Experience					
Days trout fishing	48 (0.41)	16 (0.33)	22 (0.30)	42 (0.36)	35 (0.43)
Years trout fishing	21 (0.24)	12 (0.21)	12 (0.20)	19 (0.20)	22 (0.28)
Investment (%)					
$200 or less	0.0	59.7	59.6	9.5	0.0
$201 to 500	0.0	36.8	36.5	50.4	0.0
$501 to 1000	17.8	2.0	3.2	39.8	34.8
$1,001 to 5,000	60.6	0.0	0.0	0.0	51.7
$5,001 to 15,000	16.6	0.0	0.0	0.0	10.7
$15,000 or more	5.0	0.0	0.0	0.0	2.8
Centrality					
Fishing vacations (%)					
Never taken one	23.6	73.9	84.4	50.7	38.2
1 to 3 days	23.9	15.0	10.3	23.0	25.3
4 to 7 days	28.2	9.1	4.3	19.2	20.8
7 to 10 days	16.6	0.8	0.7	4.3	10.7
> 10 days	6.6	1.2	0.0	2.4	3.9
Farthest distance traveled (%)					
0 to 50 miles	8.5	43.9	54.6	23.6	16.3
51 to 200 miles	22.4	38.3	36.2	44.7	35.4
201 to 500 miles	20.1	10.3	4.3	12.5	19.1
> 500 miles	48.6	5.5	2.1	16.5	28.7

Table 19. (Continued)

Cluster Variables	Angler Group 1	2	3	4	5
Centrality statements[3]					
Fishing is my main form of outdoor recreation.	4.1 (0.06)	3.5 (0.07)	3.0 (0.06)	3.9 (0.05)	3.9 (0.08)
I find that a lot of my life is centered around fishing.	3.7 (0.07)	3.1 (0.07)	2.3 (0.06)	3.4 (0.05)	3.6 (0.08)
I have definite preferences about the types of water I like to fish.	4.3 (0.06)	3.7 (0.06)	3.2 (0.06)	4.2 (0.05)	4.2 (0.07)
I have definite preferences about the kinds of fish I like to catch.	4.2 (0.06)	3.6 (0.06)	3.1 (0.06)	4.1 (0.05)	4.0 (0.07)
I usually fish with people of about the same skill level as myself.	3.5 (0.06)	3.3 (0.06)	2.9 (0.06)	3.4 (0.05)	3.2 (0.08)
Most of my friends have the same interests in fishing as I do.	3.3 (0.07)	3.4 (0.06)	3.1 (0.06)	3.5 (0.05)	3.4 (0.08)

[1] Measured on a five-point scale: 1 = Never; 2 = Rarely; 3 = Occasionally; 4 = Often; 5 = Always

[2] Targeted effort = days trout fishing in last year ÷ total days fishing in last year

[3] Measured on a five-point scale: 1 = strongly disagree; 2 = disagree; 3 = neutral; 4 = agree; 5 = strongly agree

Table 20. Mean (SE) age of respondents, mean (SE) age when they began fishing, and percentage of anglers achieving different levels of education and household income.

	Angler Group				
Variable	1	2	3	4	5
Age (Years)	47 (0.23)	45 (0.24)	42 (0.22)	45 (0.20)	46 (0.28)
Began fishing (Years)	11 (0.18)	10 (0.17)	12 (0.19)	10 (0.15)	8 (0.17)
Education (%)					
Some high school	3.5	12.6	11.7	12.7	7.9
High school	10.8	30.4	28.0	25.7	16.3
Vo-Tech degree	4.6	14.2	9.2	7.9	10.1
Some college	22.4	17.0	23.8	26.6	27.5
College degree	32.8	15.8	17.7	20.9	27.5
Graduate degree	25.9	7.1	7.8	6.0	10.1
Income (%)					
Less than $20,000	2.3	11.1	9.6	11.7	4.5
$20,000 – 39,999	13.9	28.1	27.7	25.5	19.7
$40,000 – 59,999	20.8	30.0	25.9	26.8	21.9
$60,000 – 79,999	18.9	13.8	14.2	14.4	19.7
$80,000 – 99,999	15.1	7.1	7.8	7.6	12.4
$100,000 or more	26.6	5.1	6.4	6.0	16.9

Table 21. Mean responses to questions about the frequency with which anglers used three common angling methods. Means within rows that share a subscript were not significantly different (paired contrasts, $P = 0.05$). Frequency was measured on a five-point scale: 1 = Never; 2 = Rarely; 3 = Occasionally; 4 = Often; 5 = Always.

Angling	Angler Groups				
Method	1	2	3	4	5
Fly fishing	4.3^{a}	1.8^{b}	2.2^{c}	2.7^{d}	3.0^{d}
Artificial lures & spinning gear	2.4^{a}	3.5^{b}	3.4^{b}	3.4^{b}	3.6^{b}
Bait fishing	2.0^{a}	3.9^{b}	3.8^{c}	3.6^{d}	3.4^{e}

Table 22. Mean responses to angling motive items for the five angler groups. Means within rows sharing the same letter were not significantly different (paired contrasts, $P = 0.05$). Scale for motive items: 1 = very unimportant, 2 = unimportant, 3 = neutral, 4 = important, 5 = very important.

	Angler Group					
Motive	1	2	3	4	5	*P*
To be outdoors	4.6[a]	4.4[b]	4.3[b]	4.6[a]	4.5[ab]	0.0001
For family recreation	3.4[a]	3.8[b]	3.6[b]	3.8[b]	3.7[b]	0.0003
To experience new things	3.7[a]	3.6[a]	3.4[b]	3.7[a]	3.6[a]	0.0493
For relaxation	4.6[ab]	4.5[a]	4.4[a]	4.6[b]	4.4[a]	0.0095
To obtain fish for eating	1.8[a]	3.2[b]	2.8[c]	3.0[c]	3.0[bc]	0.0001
For the experience of the catch	4.3[a]	4.1[b]	4.1[b]	4.5[c]	4.2[ab]	0.0001
To be with friends	3.8[a]	3.8[a]	3.8[a]	3.8[a]	3.7[a]	0.4159
To develop my skills	4.0[a]	3.5[b]	3.6[bc]	4.0[a]	3.7[c]	0.0001
To get away from the regular routine and other people	4.2[ab]	4.0[c]	4.0[c]	4.3[a]	4.1[bc]	0.0001
To catch a trophy fish	3.4[ab]	3.3[a]	3.0[c]	3.5[b]	3.3[ab]	0.0001
For the challenge or sport	4.3[a]	3.8[b]	3.8[b]	4.3[a]	4.1[a]	0.0001
To share my knowledge of fishing with others	3.4[a]	3.1[b]	2.9[c]	3.4[a]	3.2[ab]	0.0001
For physical exercise	3.2[a]	3.2[a]	3.0[a]	3.5[b]	3.2[a]	0.0001

Table 23. Mean responses to catch preference items for the five angler groups. Means within rows sharing the same letter were not significantly different (paired contrasts, $P = 0.05$). Scale for preference items: 1 = strongly disagree; 2 = disagree; 3 = neutral; 4 = agree; 5 = strongly agree.

	Angler Groups					
Statement	1	2	3	4	5	*P*
The more trout I catch, the happier I am	3.6^{a}	3.7^{a}	3.5^{a}	3.7^{a}	3.6^{a}	0.1746
Keeping trout I catch is more enjoyable than releasing them	1.4^{a}	2.7^{c}	2.3^{b}	2.3^{b}	2.6^{c}	0.0001
The bigger the trout I catch, the better the fishing trip	3.7^{ab}	3.9^{c}	3.6^{a}	3.8^{bc}	3.8^{abc}	0.0454
A fishing trip can be a success even if I catch no trout	3.8^{a}	3.6^{a}	3.7^{a}	3.8^{a}	3.7^{a}	0.1302
Catching a trophy trout is the biggest reward for me	3.3^{c}	3.0^{ab}	2.9^{a}	3.3^{c}	3.2^{bc}	0.0001
When I go fishing, I am not satisfied unless I catch something	2.7^{a}	2.9^{c}	2.7^{a}	2.9^{bc}	2.7^{ab}	0.0270
Bringing trout home to eat is an important outcome of fishing	1.6^{a}	3.0^{d}	2.6^{b}	2.8^{c}	3.0^{d}	0.0001
How I catch trout is as important to me as actually catching one	4.2^{c}	3.1^{a}	3.1^{a}	3.8^{b}	3.6^{b}	0.0001
I am just as happy if I release the trout I catch	4.7^{d}	3.7^{a}	3.9^{bc}	4.1^{c}	3.8^{ab}	0.0001
I like to fish where I know I have a chance to catch a trophy trout	4.0^{c}	3.7^{b}	3.4^{a}	3.9^{c}	3.9^{bc}	0.0001
It does not matter to me what type of trout I catch	3.9^{a}	4.0^{a}	4.0^{a}	4.1^{a}	3.8^{a}	0.0956

Table 24. Mean responses to regulation and management action items for the five angler groups. Means within rows sharing the same letter were not significantly different (paired contrasts, $P = 0.05$). Scale for regulation items: 1 = strongly oppose; 2 = oppose; 3 = neutral; 4 = support; 5 = strongly support. Scale for management action items: 1 = very unimportant, 2 = unimportant, 3 = neutral, 4 = important, 5 = very important.

	Angler Groups					
Management item	1	2	3	4	5	*P*
Regulations						
Minimum size limit	4.5^{c}	3.7^{ab}	3.7^{a}	3.9^{b}	3.7^{ab}	0.0001
Maximum size limit	4.2^{c}	2.9^{a}	2.8^{a}	3.2^{b}	3.1^{ab}	0.0001
Slot limit	3.7^{c}	3.1^{b}	2.9^{a}	3.1^{ab}	3.2^{b}	0.0001
Reduced daily creel limits	4.1^{c}	2.6^{a}	2.7^{a}	3.0^{b}	2.8^{ab}	0.0001
Prohibiting the use of bait	3.7^{c}	1.7^{a}	1.8^{a}	2.1^{b}	2.2^{b}	0.0001
Limit lures to single-hook artificials only	4.0^{c}	2.1^{a}	2.2^{a}	2.6^{b}	2.5^{b}	0.0001
Catch & release only areas	4.3^{d}	2.7^{a}	2.8^{ab}	3.2^{c}	3.1^{bc}	0.0001
Closed seasons	2.6^{b}	2.4^{ab}	2.2^{a}	2.2^{a}	2.2^{a}	0.0042
Spawning refuge areas	4.2^{b}	3.5^{a}	3.6^{a}	3.6^{a}	3.7^{a}	0.0001
Actions						
Habitat improvement	4.5^{d}	4.0^{ab}	3.9^{a}	4.2^{bc}	4.4^{cd}	0.0001
Water quality improvement	4.6^{d}	4.1^{ab}	4.0^{a}	4.3^{bc}	4.4^{cd}	0.0001
Increased access to rivers	3.4^{a}	3.6^{a}	3.5^{a}	3.6^{a}	3.5^{a}	0.6235
Increased stocking of trout	4.0^{a}	4.1^{ab}	4.1^{ab}	4.1^{ab}	4.2^{b}	0.0420

Table 25. Percentage distribution of the five angler groups for the eight tailwater fisheries included in the study and statewide.

	Angler Group				
River	1	2	3	4	5
Caney Fork	20.2	21.1	22.3	26.9	9.5
Clinch	18.9	17.9	21.6	25.0	16.6
Duck	13.2	35.8	15.1	26.4	9.4
Elk	24.7	22.2	14.8	28.4	9.9
Hiwassee	23.4	18.7	20.6	21.5	15.9
Obey	6.9	29.9	22.4	24.1	16.7
SF Holston	23.2	9.4	19.9	35.4	12.2
Watauga	26.0	6.5	23.6	35.0	8.9
Statewide	19.3	18.9	21.0	27.5	13.3

Table 26. Mean responses to catch preference items for anglers interviewed while fishing on eight tailwater rivers located across the state of Tennessee. Scale for preference items: 1 = strongly disagree; 2 = disagree; 3 = neutral; 4 = agree; 5 = strongly agree. Sample sizes are in parentheses. The probability testing the null hypothesis that the means were similar is listed for each statement.

Statement	River								All (N = 1,396)	P
	Caney Fork (250)	Clinch (394)	Duck (63)	Elk (83)	Hiwassee (110)	Obey (178)	SF Holston (195)	Watauga (129)		
The more trout I catch, the happier I am	3.6	3.6	3.6	3.6	3.5	3.5	3.7	3.7	3.6	0.9107
Keeping the trout I catch is more enjoyable than releasing them	2.2	2.2	2.2	2.2	2.3	2.8	2.1	2.1	2.3	0.0001
The bigger the trout I catch, the better the fishing trip	3.8	3.8	3.8	3.7	3.7	3.7	3.9	3.7	3.8	0.6054
A fishing trip can be a success even if I catch no trout	3.7	3.7	3.7	3.8	3.7	3.6	3.9	3.7	3.7	0.5668
Catching a trophy trout is the biggest reward for me	3.2	3.1	3.1	3.0	3.2	3.0	3.2	3.2	3.1	0.3255
When I go fishing, I am not satisfied unless I catch something	2.7	2.7	2.9	2.8	2.8	3.0	2.8	2.7	2.8	0.5840
Bringing trout home to eat is an important outcome of fishing	2.5	2.5	2.8	2.5	2.6	3.1	2.4	2.4	2.6	0.0001

Table 26. continued.

Statement	River								All (N = 1,396)	*P*
	Caney Fork (250)	Clinch (394)	Duck (63)	Elk (83)	Hiwassee (110)	Obey (178)	SF Holston (195)	Watauga (129)		
How I catch trout is as important to me as actually catching one	3.6	3.5	3.6	3.7	3.6	3.4	3.8	3.7	3.6	0.0189
I am just as happy if I release the trout I catch	4.2	4.1	4.1	4.0	4.1	3.5	4.2	4.3	4.1	0.0001
I like to fish where I know I have a chance to catch a trophy trout	3.8	3.8	3.6	3.7	3.8	3.7	3.8	3.7	3.8	0.4030
It does not matter to me what type of trout I catch	4.0	4.0	3.8	4.1	3.9	3.9	4.1	4.1	4.0	0.357

Table 27. Mean responses to regulation and management action items for anglers interviewed on eight tailwater rivers located across Tennessee. Scale for regulation items: 1 = strongly oppose; 2 = oppose; 3 = neutral; 4 = support; 5 = strongly support. Scale for management action items: 1 = very unimportant, 2 = unimportant, 3 = neutral, 4 = important, 5 = very important. Sample sizes are in parentheses. The probability testing the null hypothesis that the means were similar is listed for each statement.

	River									
Management item	Caney Fork (250)	Clinch (394)	Duck (63)	Elk (83)	Hiwassee (110)	Obey (178)	SF Holston (195)	Watauga (129)	All (N = 1,396)	*P*
Regulations										
Minimum size limit	4.1	4.0	4.0	4.0	3.8	3.6	3.9	3.9	3.9	0.0091
Maximum size limit	3.4	3.2	3.2	3.3	3.0	3.0	3.5	3.3	3.2	0.0165
Slot limit	3.4	3.0	3.3	3.1	2.9	3.1	3.5	3.2	3.1	0.0002
Reduced daily creel limits	3.2	3.0	2.9	3.2	3.1	2.5	3.2	3.4	3.0	0.0001
Prohibiting the use of bait	2.5	2.2	2.4	2.6	2.6	1.8	2.3	2.2	2.2	0.0001
Limit lures to single-hook artificials only	3.0	2.5	2.8	2.8	2.9	2.3	2.7	2.7	2.6	0.0001
Catch and release only areas	3.6	3.0	3.4	3.6	3.4	2.7	3.2	3.4	3.1	0.0001
Closed seasons	2.3	2.1	2.7	2.5	2.4	2.2	2.5	2.2	2.2	0.0435
Spawning refuge areas	3.6	3.7	3.8	3.8	3.4	3.5	4.0	3.7	3.6	0.0034
Actions										
Habitat improvement	4.1	4.2	4.6	4.2	4.1	4.0	4.3	4.3	4.2	0.0492
Water quality improvement	4.2	4.2	4.7	4.3	4.2	4.0	4.3	4.4	4.2	0.0072
Increased access to rivers	3.4	3.4	3.4	3.5	3.5	3.4	3.7	3.8	3.5	0.0481
Increased stocking of trout	3.9	4.1	4.1	4.1	4.1	4.1	4.2	4.1	4.1	0.3541

Table 28. Mean satisfaction ratings for the hypothetical size-number scenarios presented to trout anglers at eight tailwaters in Tennessee from July 2001 to January 2002. Scenarios were ranked on a five-point scale where 1 equaled 'least satisfied' and 5 equaled 'most satisfied'.

Size (mm)	Number of trout	Mean	N	Standard Deviation
203	1	1.79	161	1.13
	3	2.40	186	1.20
	5	2.62	154	1.33
	7	2.80	51	1.27
254	1	2.57	79	1.21
	3	3.29	120	1.18
	5	3.57	184	1.18
	7	3.79	119	1.20
305	1	3.38	242	1.32
	3	3.83	111	1.04
	5	4.46	134	0.80
	7	4.43	145	0.82
356	1	4.13	90	1.11
	3	4.46	111	0.86
	5	4.71	133	0.61
	7	4.78	165	0.55

Table 29. Analysis of weighted least-squares for the angler catch preference model. River, total length of trout (mm), number of trout, and the interaction between the size and number of trout independent variables for the model.

Effect	Chi-square	*P*
Intercept	153.78	0.0001
River	40.21	0.0633
Length	374.41	0.0001
Number	93.29	0.0001
Length x number	31.70	0.6731

Table 30. Mean satisfaction ratings for current trout fishing conditions at eight tailwaters in Tennessee as ranked by anglers interviewed from July 2001 to January 2002. Fishing conditions were ranked on a five point scale where 1 equaled 'least satisfied' and 5 equaled 'most satisfied'.

River	N	Mean Ranking	SE
Caney Fork	146	3.69	0.09
Clinch	360	3.09	0.06
Duck	66	3.68	0.13
Elk	49	3.16	0.15
Hiwassee	161	2.53	0.10
Obey	100	3.48	0.11
SF Holston [a]	97	4.12	0.11
Watauga [a]	106	3.31	0.10

[a] Data on rankings for the SF Holston and Watuaga Rivers were only available from September 2001 to January 2002.

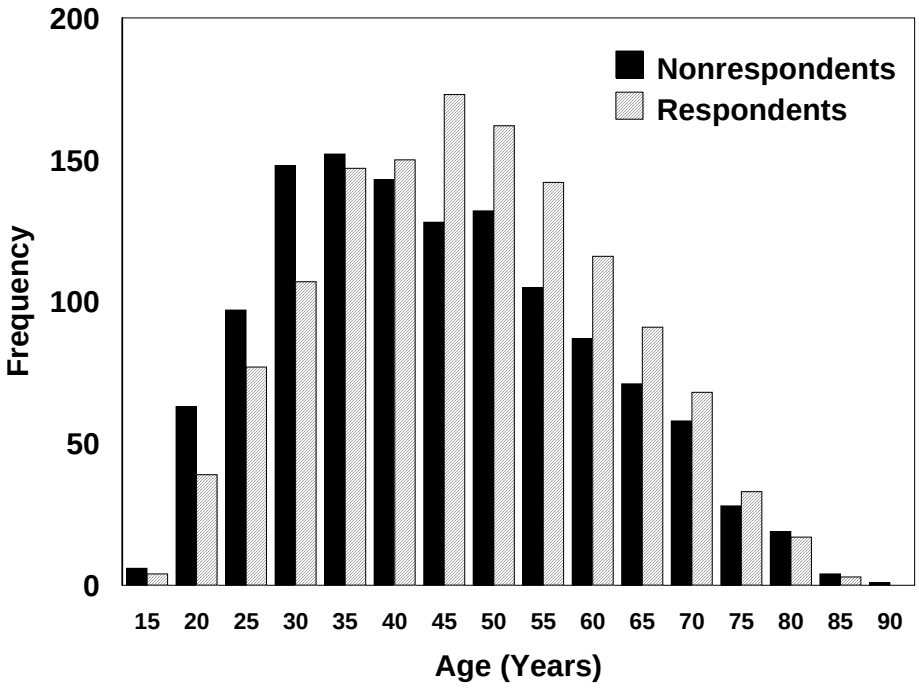

Figure 1. Age distribution of respondents and nonrespondents.

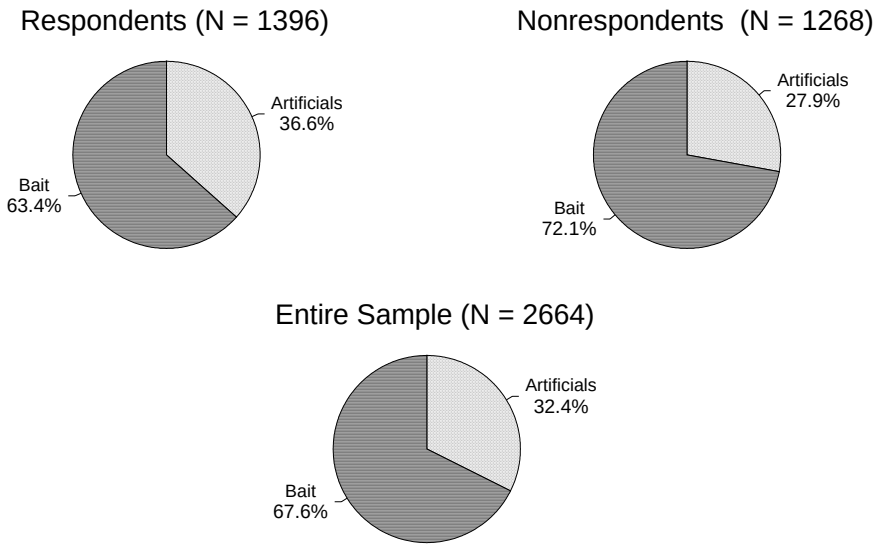

Figure 2. Percentage of mail survey respondents and nonrespondents using bait or artificial lures and flies when interviewed on-site.

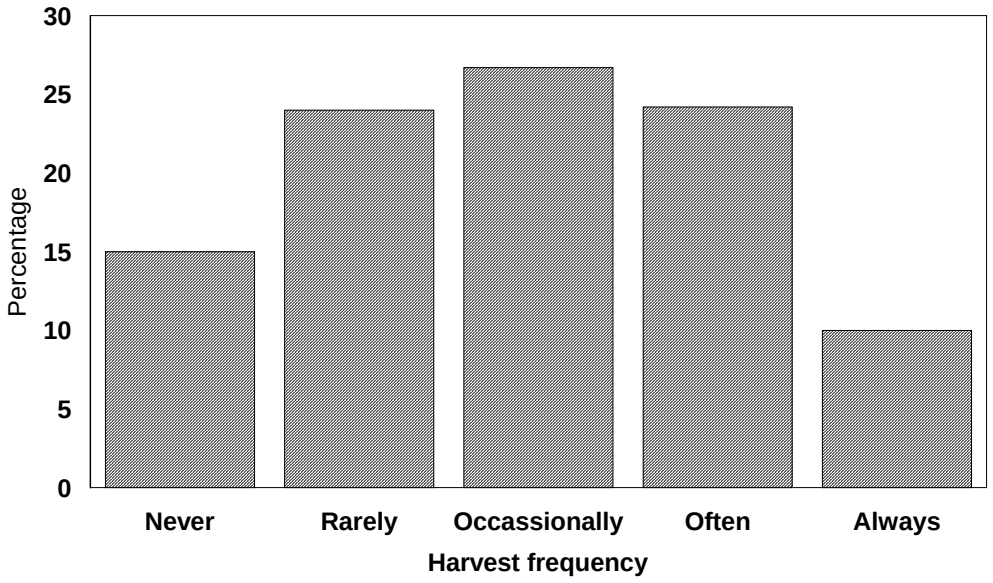

Figure 3. Self-reported harvest frequencies of survey respondents (N = 1,391).

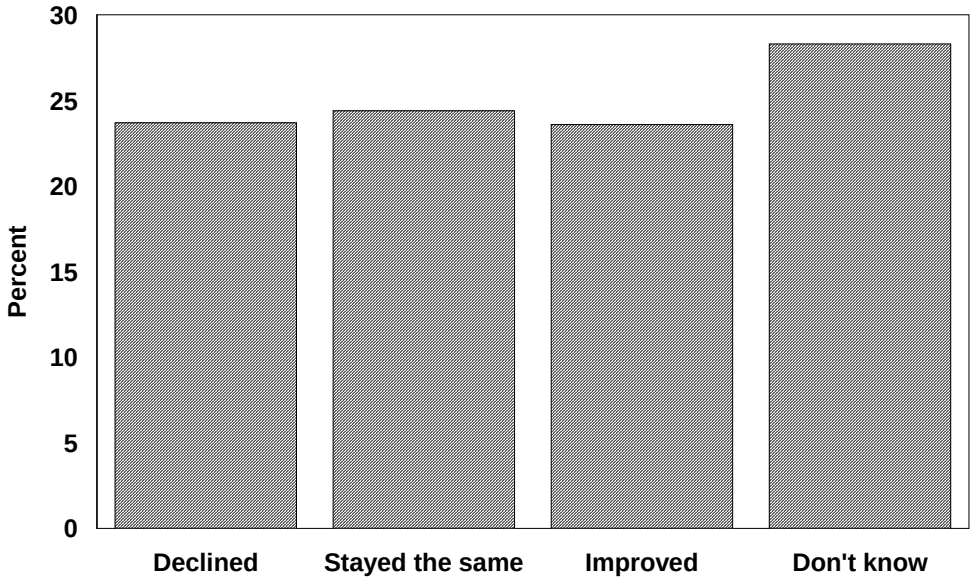

Figure 4. Survey respondent evaluation of changes in the quality of trout fishing in Tennessee's tailwater fisheries in the last five years. (N = 1,378)

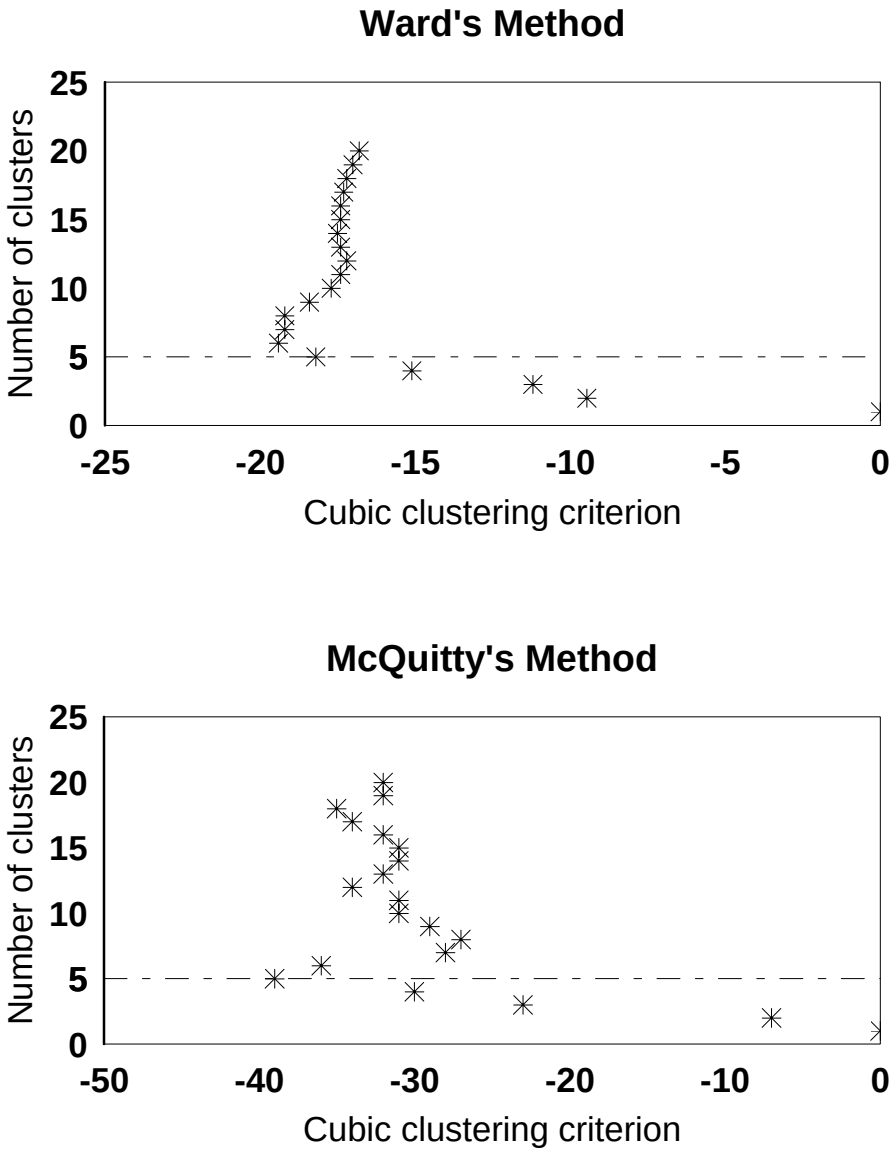

Figure 5. Cubic clustering criterion (CCC) versus the corresponding number of clusters (i.e., angler groups) generated by two hierarchical clustering methods. The CCC is a measure of the effectiveness of the clustering analysis. The CCC remains fairly constant as long as the analysis continues to match similar groups. The CCC shifts sharply when the analysis begins to combine dissimilar groups. The two graphs illustrate a sharp change in the CCC after the analysis created fewer than 5 clusters, suggesting that 5 is the optimum number of clusters.

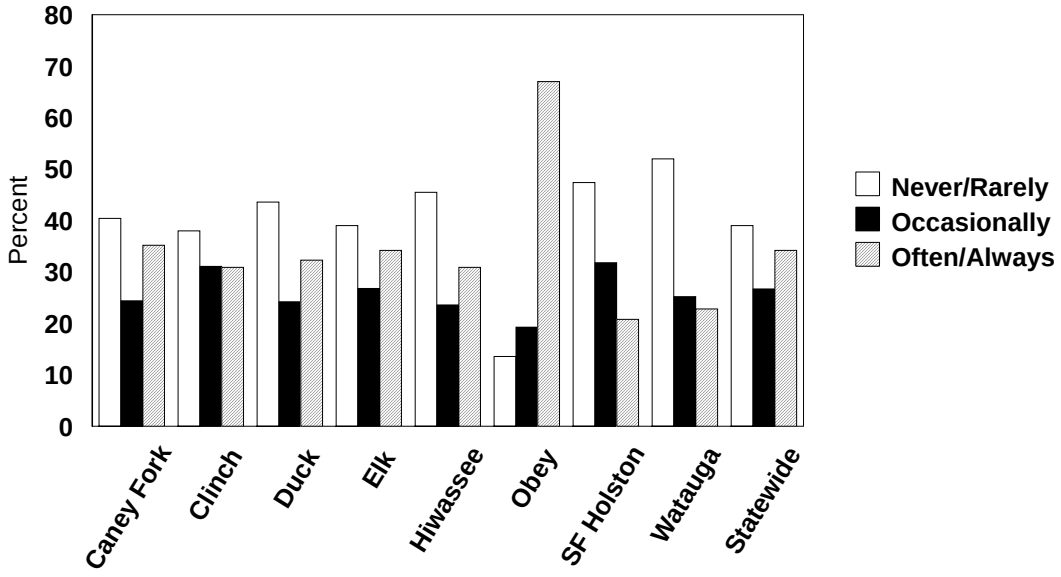

Figure 6. Self-reported harvest frequencies for survey respondents interviewed on eight tailwater rivers and statewide.

APPENDIX A

TAILWATER COMPARISONS

Table A1. Comparison of eight trout fisheries located in Tennessee (TWRA, unpublished data).

Variable	Caney Fork	Clinch	Duck	Elk	Hiwassee	Obey	SF Holston	Watauga
Start of survey	3/15/97	3/1/01	5/1/00	4/4/95	1/30/99	3/1/01	3/1/97	5/28/98
End of survey	10/25/97	10/31/01	10/31/00	10/31/95	11/20/99	10/31/01	10/31/97	11/6/98
River reach sampled (km)	26	20	15	22	30	7	22	26
No. rainbow trout stocked in survey year[A]	105,946	33,300	52,951	49,923	100,000	N/A	51,222	42,152
No. brown trout stocked in survey year[A]	17,762	20,005	N/A	10,210	17,500	N/A	17,512	17,568
Total pressure over survey period (h)	65,991	87,081	20,089	14,340	73,842	27,945	100,866	65,188
Pressure per week	2,062	2,500	744	552	1758	798	2882	2,037
Mean trip time (h)[B]	3.10	3.57	2.23	3.11	N/A	2.56	3.47	3.17
No. of trips over survey period	21,287	24,392	9,000	4602	N/A	10,914	29,028	20,564
Pooled catch rate (No./h) – rainbow trout	0.83	0.62[D]	0.84	0.78	N/A	1.14	1.10[D]	1.40[D]
Pooled catch rate (No./h) – brown trout	0.15	N/A	N/A	0.52	N/A	0.05	N/A	N/A
Mean number of trout caught per trip	3.3	1.9	0.6	4.7	4.3	3.9	3.8	4.6

Table A1. Continued

Variable	Caney Fork	Clinch	Duck	Elk	Hiwassee	Obey	SF Holston	Watauga
Mean number of trout harvested per trip	1.2	0.8	0.4	1.0	1.15	3.0	1.25	0.79
Number of rainbow trout harvested	32,239	18,149	8,085	5,211	21,828	25,280	28,609	16,790
Number of brown trout harvested	4,907	1,160	N/A	2,058	1,631	720	7,660	4,612
Percent of anglers fishing with bait	69	71	66	21	39	67	62	68
Percent of anglers fly fishing	13	17	8	25	30	6	N/A	18
Percent of out-of-state anglers	2	5	3	25	22	20	30	10
Percent of non-local[C] Tennessee anglers	79	69	42	49	86	91	94	7

[A] "Catchable" (greater than or equal to 200 mm total length) trout only

[B] Based on completed trips only

[C] Non-local = anglers that did not reside in counties adjacent to tailwater0

[D] Pooled catch rates for rainbow trout and brown trout combined

APPENDIX B

MAIL SURVEY

Tennessee Tailwater Trout Angler Survey

DIRECTIONS FOR FILLING OUT THE QUESTIONNAIRE

- Please try to answer what you believe to be true for you. The best answer is the one which most closely reflects your own feelings and beliefs, or what you actually did.

- It is important that the person whom this questionnaire is addressed fills it out. This will ensure representativeness.

- We are interested in hearing from everyone who receives this survey, not just those who fish a lot. Please answer this survey even if you do not fish very much or trout fishing in tailwaters is not very important to you.

- Do not write your name on the questionnaire.

- Your answers will be treated confidentially. The questionnaire has an identification number so that your name can be checked off our list when you return your survey.

- Return the questionnaire using the addressed, pre-paid return envelope provided.

THANK YOU FOR YOUR COOPERATION!

1) Please check any of the following tailwaters you have fished in the last twelve months. (Check all that apply)

__ Dale Hollow tailwater (Obey River)
__ Center Hill tailwater (Caney Fork River)
__ Normandy tailwater (Duck River)
__ Tims Ford tailwater (Elk River)
__ South Holston tailwater (South Fork of the Holston River)
__ Norris tailwater (Clinch River)
__ Appalachia tailwater (Hiwassee River)
__ Wilbur tailwater (Watauga River)

2) Which of the tailwaters above did you fish most frequently in the last 12 months?

Name of water _____

3) Which of the tailwaters above do you prefer to fish the most?

Name of water _____

4) What three groups of fish species do you most <u>prefer</u> to fish for? Please rank them in their order of preference from most preferred (1) to least preferred (3).

__ Black Bass (largemouth, smallmouth)
__ Striped bass and white bass
__ Panfish (bream, sunfish, rock bass)
__ Crappie
__ Catfish
__ Trout (Brown, rainbow, brook)
__ Walleye and sauger
__ Other (please list) _____

5) Please indicate how frequently you use the following fishing methods for trout.

	Never	Rarely	Occasionally	Often	Always
(a) Fly fishing…….	1	2	3	4	5
(b) Artificial lures/spinning gear	1	2	3	4	5
(c) Bait fishing…….…..	1	2	3	4	5

6) Who do you usually fish with?

(1) I usually fish alone.
(2) I usually fish with family members.
(3) I usually fish with friends.

7) How many days did you go fishing in the last 12 months?…. _____ Days

8) How many of those days were spent fishing for trout?…….. _____ Days

9) How many years of fishing experience do you have?…….. _____ Years

10) How many years of trout fishing experience do you have?...._____ Years

11) How do you rate yourself as a trout angler?

(1) Beginner (2) Somewhat experienced (3) Experienced (4) Expert

12) Please check all the fishing or related conservation groups you are currently a member of.

__ Trout Unlimited, Chapter: _____
__ Federation of Fly Fishers, Chapter: _____
__ Izaac Walton League __ North American Fishing Club
__ Local fishing club: (Please list)_____
__ Other: (Please list)_____
__ None

13) How many fishing related magazines do you subscribe to? _____
a) How many of those magazines contain articles on trout fishing? _____

14) Please indicate how frequently you fish in the following ways when fishing for trout in tailwaters?

	Never	Rarely	Occasionally	Often	Always
(a) From a boat or canoe with a motor…….	1	2	3	4	5
(b) From a boat, canoe or float tube without a motor……	1	2	3	4	5
(c) From the shore……	1	2	3	4	5
(d) By wading……...	1	2	3	4	5

15) Do you own a boat that you use for trout fishing?

(1) Yes (2) No {if no, go on to question 16}

15 a) What type of boat it is?

(1) johnboat (3) canoe
(2) McKenzie (4) other _____

16) Please estimate your total investment in trout fishing equipment at the present time. This should include any boats from question 15, rods/reels, waders, nets, creels/stringers, bait buckets, fishing vests, tackle boxes, lure/fly making kits, and the like. Do <u>not</u> include lures, terminal tackle, or fishing line as these items are regularly lost and replaced and are difficult to give an accurate value.

(1) $200 or less (3) $501-1000 (5) $5,001-15,000
(2) $201-500 (4) $1,001-5,000 (6) $15,000 or more

17) Do you ever go on vacations specifically for trout of salmon fishing?

(1) Yes (2) No {go on to question 18}

17 a) If YES, how long do they usually last?

(1) 1 to 3 days
(2) 4 to 7 days
(3) 7 to 10 days
(4) More than 10 days

18) What is the greatest distance you have traveled (one-way) for the specific purpose of trout or salmon fishing?

(1) 0 to 50 miles
(2) 51 to 200 miles
(3) 201 to 500 miles
(4) More than 500 miles

19) Below is a list of reasons why people fish. Please circle the number that best indicates how important each item is to you as a reason for fishing where 1 = very <u>unimportant</u> and 5 = very <u>important</u>.

	Very Unimportant	Somewhat Unimportant	Neutral	Somewhat Important	Very Important
(a) To be outdoors……..	1	2	3	4	5
(b) For family recreation……	1	2	3	4	5
(c) To experience new and different things……...	1	2	3	4	5
(d) For relaxation……...	1	2	3	4	5
(e) To be close to the water……	1	2	3	4	5
(f) To obtain fish for eating……	1	2	3	4	5
(g) To get away from the demands of other people……...	1	2	3	4	5
(h) For the experience of the catch…….	1	2	3	4	5
(i) To test my equipment……	1	2	3	4	5
(j) To be with friends…….	1	2	3	4	5
(k) To experience natural surroundings	1	2	3	4	5
(l) To develop my skills…….	1	2	3	4	5
(m) To get away from the regular routine……	1	2	3	4	5
(n) To catch a trophy fish……...	1	2	3	4	5
(o) For the challenge or sport…….	1	2	3	4	5
(p) To experience adventure and excitement…….	1	2	3	4	5
(q) To share my knowledge of fishing with others……..	1	2	3	4	5
(r) For physical exercise…….	1	2	3	4	5
(s) Other (please list)					
_____	1	2	3	4	5
_____	1	2	3	4	5

20) Please indicate the extent to with you agree of disagree with the following statements. 1 = Strongly Disagree and 5 = Strongly Agree

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
(a) The more trout I catch, the happier I am……	1	2	3	4	5
(b) Keeping the trout I catch is more enjoyable than releasing them……	1	2	3	4	5
(c) The bigger the trout I catch, the better the fishing trip……..	1	2	3	4	5
(d) A fishing trip can be successful even if I catch no trout……...	1	2	3	4	5
(e) Catching a trophy trout is the biggest reward for me……	1	2	3	4	5
(f) When I go fishing, I am not satisfied unless I catch something……	1	2	3	4	5
(g) Bringing trout home to eat is an important outcome of fishing…….	1	2	3	4	5
(h) How I catch a trout is as important to me as actually catching one……...	1	2	3	4	5
(i) When I go fishing, I am just as happy if I don't catch a trout……..	1	2	3	4	5
(j) I am just as happy if I release the trout I catch……	1	2	3	4	5
(k) If I thought I wouldn't catch any trout, I wouldn't go fishing……	1	2	3	4	5
(l) I like to fish where I know I have a chance to catch a trophy trout……	1	2	3	4	5
(m) It does not matter to me what type of trout I catch……	1	2	3	4	5
(n) A full stringer is the best indication of a good fishing trip……..	1	2	3	4	5

21) Overall how satisfied are you with trout fishing in Tennessee's tailwaters? Please circle one number from the scale of 1 to 5 where 1 is very unsatisfied and 5 is very satisfied.

Very Unsatisfied				Very Satisfied
1	2	3	4	5

22) Over the past 5 years, the quality of trout fishing in Tennessee's tailwaters has…

(1) Declined
(2) Stayed the same
(3) Improved
(4) Don't know

23) How often do you keep the trout that you catch?

(1) Never (2) Rarely (3) Occasionally (4) Often (5) Always

24) Please indicate the extent to which you agree or disagree with the following statements.

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
(a) Fishing is my main form of outdoor recreation……	1	2	3	4	5
(b) I get greater satisfaction out of fishing than my work…….	1	2	3	4	5
(c) I find that a lot of my life is centered around fishing……	1	2	3	4	5
(d) My choice of career was (or will be) influenced in some way by my interest in fishing……	1	2	3	4	5
(e) One of the main reasons I live where I do is that it has opportunities for fishing……...	1	2	3	4	5
(f) I have definite preferences about the types of water I like to fish…….	1	2	3	4	5
(g) I have definite preferences about the kinds of fish I like to catch…….	1	2	3	4	5
(h) I usually fish with people of about the same skill level as myself…….	1	2	3	4	5
(i) Most of my friends have the same interests in fishing as I do……..	1	2	3	4	5

25) To what extent would you support or oppose the following regulations if they were applied to the tailwater you fish most often to improve fishing quality?

	Strongly Oppose	Oppose	Neutral	Support	Strongly Support	Don't know
(a) Increased minimum size limits (releasing fish below a certain length)……..	1	2	3	4	5	6
(b) Maximum size limits (releasing fish above a certain length)……..	1	2	3	4	5	6
(c) Slot limits (releasing fish within a certain length range, but keeping fish above and below this range)……	1	2	3	4	5	6
(d) Reduced daily bag limits (creel limits)…….	1	2	3	4	5	6
(e) Prohibiting the use of bait…..	1	2	3	4	5	6
(f) Prohibiting the use of certain types of fishing gear……	1	2	3	4	5	6
(g) Catch and release only areas	1	2	3	4	5	6
(h) Closed season…….…	1	2	3	4	5	6
(i) Refuge areas (river sections closed to fishing at certain times of the year)……...	1	2	3	4	5	6
(j) Quality zones (include gear, creel, and size restrictions)……..	1	2	3	4	5	6

26) In your opinion, how important are the following to the future maintenance or improvement of trout fishing in Tennessee's tailwaters?

	Very Unimportant	Somewhat Unimportant	Neutral	Somewhat Important	Very Important
(a) Habitat improvement	1	2	3	4	5
(b) Water quality improvement	1	2	3	4	5
(c) Increased access to the rivers	1	2	3	4	5
(d) Increased stocking of trout	1	2	3	4	5

"The following questions pertain to the river and fishing trip you were on when you were approached by our staff (refer to cover letter). These questions will be used to estimate the economic value of the trout fishery in this river and are not linked to the cost of a fishing license."

27.) If the fishing conditions you experienced on that trip were the same, but the cost to make the trip had been $____ higher than what you actually spent, would you still have made the trip? Yes_____ No_____

28.) If you were twice as likely to catch seven trout on that trip, but the cost to make the trip had been $____ higher than what you actually spent, would you still have made the trip? Yes_____ No_____

29.) If you were twice as likely to catch a trout larger than 16 inches on that trip, but the cost to make the trip had been $____ higher than what you actually spent, would you still have made the trip? Yes_____ No_____

30.) If the cost to make that trip were $____ higher than what you actually spent, but there was no chance of having to stop or cancel the trip due to unpredictable flows, would you still have made the trip? Yes_____ No_____

"The following questions are meant to help us describe trout anglers in general. The information you provide will remain strictly confidential, but is important to our study."

31) What is your age? _____ Years

32) What is your gender? (1) Male (2) Female

33) What is your city or town of residence? _____

34) What is you county of residence? _____

35) What is your state of residence? _____

36) Which of the following best describes the area where you now reside?

__ A city of 1,000,000 or more people
__ A city of 250,000 to 999,999 people
__ A city of 50,000 to 249,999 people
__ A city or town of less than 50,000 people
__ A rural area

37) At what age did you begin fishing? ____

38) What is your marital status?

__ Single __ Married __ Other

39) What is the highest level of formal education you have completed?

__ Some high school
__ High school degree
__ Vocational or technical degree
__ Some college
__ College degree
__ Post graduate degree

40) What was your household's 2000 annual income before taxes?

__ Less than $10,000
__ $10,000-19,999
__ $20,000-29,999
__ $30,000-39,999
__ $40,000-49,999
__ $50,000-59,999
__ $60,000-69,999
__ $70,000 or more

THANK YOU VERY MUCH FOR COMPLETING THIS SURVEY.

You have been very generous with your time and we are extremely grateful for that. The results of this study will be used to help guide future management of Tennessee's tailwater, trout fisheries. Please return the questionnaire using the postage paid, pre-addressed envelope that we provided.

We welcome any comments you may wish to add. Please write them below.